

03.2021

NATIONAL GEOGRAPHIC



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On the Cover

We've been fascinated for millennia by Mars, seen here in images taken by (from top) the European Space Agency's Mars Express, and the Viking Orbiter 1.

EUROPEAN SPACE AGENCY—ESA;
NASA/USGS

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The 'Train Ladies' of Ukraine

A tradition as old as rail travel in Ukraine, these safety signal officers work in tiny houses at rail crossings, and help keep things on track.

PHOTOGRAPHS BY
SASHA MASLOV

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AND CHRISTINA SHINTANI

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Our Obsession With Mars Missions

Since sky-watchers in the third millennium B.C. described it as a “wandering star,” Mars has fascinated people on Earth. It so intrigues us that by this month, 11 spacecraft and rovers are expected to be on or near the red planet.
BY NADIA DRAKE
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Imprisoned While Innocent

Thanks to scrutiny of the actions of prosecutors, public defenders, and police, as well as advances in DNA analysis and other sorts of forensic testing, 182 people have been found innocent and exonerated from death row since 1972.
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Flex your antioxidant muscles.



The Antioxidant Superpower, POM Wonderful, has 700 mg of polyphenol antioxidants in every 8oz bottle. Making it the perfect workout partner the next time you hit the gym.

DEATH-ROW
EXONERATIONS

The Costs of Wrongful Convictions

BY SUSAN GOLDBERG PHOTOGRAPH BY MARTIN SCHOELLER

SINCE 1972, 180 MEN AND TWO WOMEN in the United States have been freed from death row after being found innocent of the crimes for which they were sentenced to die. Martin Schoeller, a longtime *National Geographic* contributor known for his haunting, close-up portraits, has photographed, filmed, and interviewed 17 of them.

Schoeller brought these photos to us and our colleagues at ABC News (both organizations are owned by The Walt Disney Company). His goal: He wants people to reconsider their support for the death penalty, which today in America can be imposed by 28 states, the federal government, and the military. Schoeller hopes that people who see his photos “feel like ‘This could have been me—and they were sentenced to death for something they didn’t do.’ That’s the reason I did this: To create work that will change some people’s hearts.”

Whether you support or oppose the death penalty, there’s no question that Schoeller’s portraits and stories of exonerated former prisoners are powerful. These people were caught up in a Kafkaesque nightmare, often caused by police or prosecutorial misconduct, or witnesses who lied or were mistaken. Most of the wrongly convicted had poor legal representation; disproportionate numbers of them were people of color, from low-education and low-income backgrounds. They sat on death row, typically in solitary confinement, sometimes for decades. They missed their own parents’ funerals. Their children grew up without them.

Ultimately, they were freed by DNA evidence, better lawyers, or events that caused the truth of their innocence to come out. After all that, most are managing to go on, reclaiming their



lives with varying degrees of success.

Schoeller has a unique perspective on how they do it. For another recent project, he has been taking portraits of now elderly survivors of the Holocaust. He’s found that the two groups have something important in common, he told me: “They are able to forgive. There are so many reasons that you can be hateful and mad at people, but you have to have the ability to forgive. Otherwise it just eats you up,” he said. “The people who can’t get to that conclusion emotionally, they don’t make it.”

For most of *National Geographic*’s 133 years, photography has been central to our mission. Martin Schoeller’s portraits remind us why: Because even in a streaming-media age, still photos can reveal indelibly powerful stories.

Thank you for reading *National Geographic*. □

Derrick Jamison (above) spent 20 years on death row before his wrongful conviction was overturned. He’s now a member of Witness to Innocence, the anti-death penalty group co-founded by Sister Helen Prejean and death-row exoneree Ray Krone. Martin Schoeller (below) raised funds for the group as part of his project to photograph men and women who’ve been freed from death row. Schoeller’s project will be the subject of an ABC News prime-time special this spring.





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P R O O F

NATIONAL GEOGRAPHIC



PHOTOGRAPHS BY **SASHA MASLOV**

LOOKING AT THE EARTH FROM EVERY POSSIBLE ANGLE



UKRAINE'S 'TRAIN LADIES'

Along the country's railroad system, tiny houses shelter signal attendants who help keep travel safe.

VOL. 239 NO. 3

Railway attendant Inna Oleksandrivna Manoylenko, at work on the outskirts of Kyiv, is one of thousands of Ukrainian railway employees who signal to passing trains and keep impatient people off the tracks.





Nataliia Yuriivna Pylypenko passes time between trains by tending the garden at this trackside house, which is owned by the Ukrainian railway.



Signal jobs like these have long been held by women, a holdover from the Soviet era when the government influenced workplace gender roles. As the women retire, some men are taking their place.



Kononivka Station, 113 km, is one of many stations known by their name and distance from a main city. That usually means Kyiv, but some retain their Soviet-era distance measure from Moscow.



No two railway houses look the same, but common traits are their small size—a single-story may be about 225 square feet—and their location near rail crossings. The workers' lives revolve around train schedules.

THE BACKSTORY

FROM TINY TRACKSIDE HOUSES, UKRAINIAN SIGNAL OFFICERS
KEEP TRAINS RUNNING SMOOTHLY AND MOTORISTS SAFE.

MANY OF SASHA MASLOV'S best childhood memories are connected to trains. Every vacation, every trip to another city, he'd stare out the window to see the texture of his country in the apartment buildings and shops and cars waiting for the train to pass. And every so often, he'd see a tiny house with a woman standing by it, holding a yellow flag.

"Ukrainian railroad ladies," as Maslov calls them in his portrait series, are a cultural tradition that feels as old as rail travel in Ukraine. The workers are tasked with sending flag-based signals to conductors of approaching trains. A folded yellow flag means all clear ahead. An unfolded flag means reduce speed and proceed with caution. A red flag—or a flare shot into the air—means to stop moving entirely, as a hazard is ahead.

Some aspects of rail officer life are

changing. The officers are no longer all women, and the Ukraine Railways agency, Ukrzaliznytsia, has expanded its hiring to try to bring more young workers into the unglamorous but stable work.

In a world of high-speed trains and automated crossings, rail attendants today may spend less time signaling to trains than policing and warning motorists. "Ukrainians are notoriously not law-abiding," Maslov comments. "If there is no watcher, people will go around the barriers to beat a moving train."

The life can be monastic. In between trains, the workers tend gardens, complete chores, and fill out paperwork. In one house, Maslov saw a notebook in which an attendant had taken down the license plate numbers of cars that ran through barriers. She sent the list to the police. —DANIEL STONE



Ukraine's colorful crossing houses provide a public service and are a cultural touchstone.



When ‘Natural’ Disasters Aren’t

PERHAPS FIRES, STORMS, AND VIRUSES FED BY CLIMATE CHANGE
SHOULD BE CALLED WHAT THEY ARE: MAN-MADE NATURAL DISASTERS.

BY ELIZABETH KOLBERT

A

AT A NEWS CONFERENCE in mid-August of last year, California’s governor, Gavin Newsom, announced that there were 367 “known” wildfires burning in the state. “I say ‘known’ fires,” Newsom said, “but the prospect of that number going up is very real.” A couple of days later the number did, in fact, increase, to 560. A few weeks after that, many of the blazes were still burning, and one—the Doe fire, north of Santa Rosa—had grown into the largest conflagration in California history. The smoke from the state was so bad that it veiled the sun in New England. By the time most of California’s flames had been put out in late November, at least 31 people had been killed and tens of thousands evacuated.

Even as more than 15,000 firefighters were battling the California wildfires, Hurricane Laura was bearing down on Louisiana. As it passed over the Gulf of Mexico, it strengthened at a near-record rate. In just 24 hours it zoomed from a Category 1 to a Category 4

storm. By the time it hit Cameron Parish, early in the morning of August 27, it was the fifth fiercest hurricane to make landfall in U.S. history. The storm caused at least 16 U.S. deaths and up to \$12 billion in damages.

Twenty years ago, crises like the Doe fire and Hurricane Laura could have been described as “natural disasters.” Thanks to climate change, this is no longer the case. Right around the time of Newsom’s press conference, the mercury in Death Valley hit 130°F, the highest temperature ever reliably recorded on Earth. A hotter, drier California is much more likely to burst into flames. The Gulf too is heating up, with dangerous consequences. Hurricanes draw their energy from the warmth of the surface waters and so are becoming stronger and more apt to intensify. I’ve been reporting on climate change for almost two decades, and I’ve come to think that we need a new term to describe these events. Perhaps we should call them “man-made natural disasters.”

People now play such a dominant role on the planet, it’s said we live in a new geological epoch: the Anthropocene. By cutting down forests and digging mines and building cities, we’ve transformed half of the ice-free land on Earth. (Indirectly, we’ve altered half of what remains.) With our fertilizer plants, we fix more nitrogen than all terrestrial ecosystems combined; with our plows and bulldozers, we move around more earth than all the world’s rivers and streams. In terms of biomass, the numbers are staggering. People now outweigh wild mammals by a ratio of more than 8 to 1. Add in our domesticated animals (mostly cows and pigs), and the ratio’s almost 23 to 1. In the Anthropocene, all sorts of catastrophes straddle the line between man and nature. Many earthquakes, for example, are now triggered by human activity, in particular fracking. An unusually strong human-induced quake that shook Pawnee, Oklahoma, a few years ago was felt all the way to Des Moines, Iowa.

And then there’s COVID-19.

The virus that causes COVID seems to have originated in horseshoe bats. It appears to have made the leap to people near the city of Wuhan, China, either directly or through an intermediate species that has yet to be identified. Pathogens have, presumably, been jumping between animals and humans for as long as both have been around. But for most of human history, such “spillover events” were limited in their impact. Infected populations didn’t move very far or very fast. With jet travel, a virus can now make it halfway around the world between evening newscasts. Within a month of the first confirmed cases in central China, COVID had reached at least 26 other countries. Soon it was just about everywhere, even such remote places as the Falkland Islands and the Kamchatka Peninsula.

Just as with their predecessors, it’s hard to predict when or where man-made natural disasters will strike. Still, the trend lines are clear. As people increasingly destroy other animals’ habitats and move species around the world, outbreaks of novel





diseases will become more common. Author (and frequent *National Geographic* contributor) David Quammen has put it this way: “We disrupt ecosystems, and we shake viruses loose from their natural hosts. When that happens, they need a new host.” Often, that new host is going to be us.

Meanwhile, as the climate continues to warm, conflagrations will grow even larger and storms more damaging. A recent study showed that in California, the frequency of dangerous “fire weather” days has more than doubled over the past four decades. By the end of the century, it could double again. Ten or 20 years from now, last year’s record-breaking fires and floods will almost certainly have been overtaken by new record breakers. As Andrew Dessler, a professor of atmospheric sciences at Texas A&M University, observed last fall, “If you don’t like all of the climate disasters happening in 2020, I have some bad news for you about the rest of your life.”

What’s to be done? According to one school of thought, the best way to deal with human intervention in the natural world is to intervene better. Old technologies got us into this situation; new ones will get us out. Advocates of this view note the extraordinary advances that are being made all the time, in fields ranging from computing to genetics to material science. To make it easier to find treatments for COVID-19, Chinese researchers genetically altered mice to possess the same virus receptors as humans. The scientists used a technique known as CRISPR, which over the past few years has revolutionized gene editing. To combat climate change, engineers have built machines that suck carbon dioxide out of the air. Today the numbers are limited, but perhaps one day they’ll be as common as iPhones.

Alternatively, it’s been proposed that climate change could be counteracted by blocking some of the sun’s incoming rays. Researchers are working on technologies to brighten clouds, which would bounce more sunlight out to space. Another technique, known as “solar geoengineering,” would spread reflective particles in the stratosphere, providing the entire planet with a kind of sunshade.

“Ironically, such engineering efforts may be the best chance for survival for most of the Earth’s natural ecosystems,” Daniel Schrag, director of the Harvard University Center for the Environment, has written. However, he noted, perhaps the ecosystems “should no longer be called natural if such

TEN OR 20 YEARS FROM NOW, LAST YEAR’S RECORD-BREAKING FIRES AND FLOODS WILL ALMOST CERTAINLY HAVE BEEN OVERTAKEN BY NEW RECORD BREAKERS.

engineering systems are ever deployed.”

Another school of thought argues that the new world-altering technologies are likely to have much the same impact as the old world-altering technologies, only with higher stakes. Consider the example of chlorofluorocarbons. These compounds were first synthesized in the late 1920s in the hope of solving the problems caused by early refrigerants, such as ammonia, which were toxic. Billions of pounds of chlorofluorocarbons were produced before it was discovered, in the 1980s, that the chemicals were destroying the ozone layer, which shields the Earth from ultraviolet radiation.

Despite a global ban on chlorofluorocarbons, the chemicals still are being produced illegally, and every year a “hole” in the ozone opens up over the Southern Hemisphere. Shooting reflective particles into the stratosphere could further damage the ozone layer. It also could cause other problems that have not been—and perhaps never can be—fully anticipated. Critics have described the very idea of solar geoengineering as “utterly mad,” “dangerous beyond belief,” and “a broad highway to hell.”

As for me, I feel tugged in both directions. The choice we face is not whether to change the world; that decision unfortunately has been made. The decision going forward is *how* are we going to change it? Over the years I’ve interviewed scores of scientists, inventors, and entrepreneurs, and I’m continually impressed by how ingenious humans are as a species. But then the wind blows in smoke from 3,000 miles away, and I’m reminded of how dangerous we are as well. □

Elizabeth Kolbert is a staff writer for the *New Yorker*, a regular contributor to *National Geographic*, and a two-time National Magazine Award winner. This essay is adapted from her new book, *Under a White Sky*. Her previous book *The Sixth Extinction* received the 2015 Pulitzer Prize for General Nonfiction.

Making grim history

In 2020 “man-made natural disasters” broke records.

Sept. 9: The Doe fire became the largest in California’s history.

Oct. 14: The Cameron Peak fire became the largest in Colorado’s history.

Oct. 5-6: Hurricane Delta set a new record for the fastest intensification from a tropical depression to a Category 4 hurricane in the Atlantic Basin.

Nov. 1: Super Typhoon Goni became the strongest tropical cyclone to make landfall, hitting the Philippines with winds of 195 mph.

DISPATCHES
FROM THE FRONT LINES
OF SCIENCE
AND INNOVATION

Sniffing out the deadly virus

Scientists are training working dogs to detect COVID-19-related compounds in human sweat. Sniffers such as Floki (right), an English springer spaniel at Australia's University of Adelaide, could be deployed to airports, hospitals, and other facilities worldwide to help screen for the virus. —HW



ADAPTATION

Evolving to Evade Harvest

For centuries in China's Hengduan Mountains, herbalists have collected *Fritillaria delavayi* plant bulbs for use in traditional medicine. A recent study found some *F. delavayi* have changed color from light green to gray or brown to match their rocky habitat—a camouflaging more common in heavily picked areas. It seems this clever plant is evolving to be less visible to its primary predator: humans. —HICKS WOGAN

FOSSIL FIND

ANCIENT BUG ZAPPER

ANALYSIS REVEALS FOSSIL IS THE OLDEST KNOWN EXAMPLE OF A SLINGSHOT-TONGUED AMPHIBIAN.



AN AMBER-ENTOMBED FOSSIL with an exquisitely preserved skull (left)—even some muscles intact—is the oldest known example of a slingshot tongue, found in amphibians called albanerpetontids. Details about “albies” have been elusive; another albie fossil previously was misidentified as its distant cousin the chameleon. But new analysis by Sam Houston State University researcher Juan Daza and his colleagues identified **this fossil, above,*** from Myanmar, as a new albie species that lived 99 million years ago. Writing in *Science*, Daza's team added to albies' profile: Lizardlike, with scales and claws, likely living in or around trees, these sit-and-wait predators used their long, powerful tongues to nab small invertebrates. —DINA FINE MARON

*



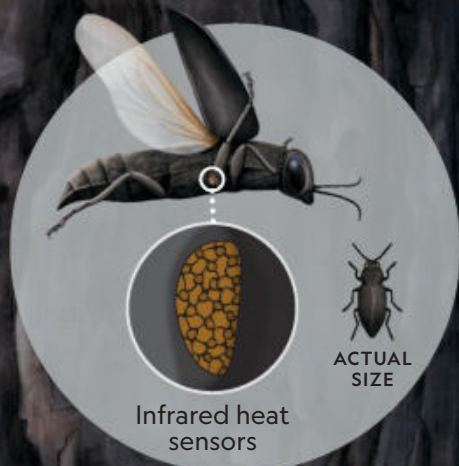
LIFE AFTER FIRE

Black-backed woodpeckers are known as ecosystem engineers—and they prefer their forests burned. Each year these birds drill nesting cavities in fire-damaged forests, where they blend in well. They also dine on wood-boring beetles that thrive amid the ashes. Marvels of anatomy, they can peck into some of the hardest trees thousands of times a day without sustaining concussions or other physical harm. **BY TAYLOR MAGGIACOMO**

Black fire beetle larva

Three toes They can lean back farther, and thus strike harder, than four-toed species.

Black fire beetle
Melanophila acuminata



1

BEETLES SENSE HEAT Hours after fire

Wood-boring fire beetles use heat sensors to find burned trees miles away, where they lay their eggs.

Powerful beak
Chisel-like beaks are covered in tough keratin.

Resilient bone
The front of the skull is thick, spongy bone that acts as a shock absorber.

Head protection
A small, smooth, and dense brain rarely collides with the skull as the bird pecks.

Extra eyelids
Specialized third eyelids (nictitating membranes) keep out flying debris.

Versatile tongue
A long tongue and tongue bone can dislodge insects and decrease vibrations.

Pecking muscles
Exceptionally fast neck muscle contractions help with powerful pecking.

Black-backed woodpecker (male)

..... **Supporting tail feathers**
Sturdy, stiff tail feathers brace the bird as it perches against a tree.

2

FEASTING Months after fire

Woodpeckers hunt for wood-boring beetle larvae, their main food source. The birds have usually colonized an area by the first spring after a fire.



Black-backed
woodpecker range
(*Picoides arcticus*)

ALASKA
(U.S.)

CANADA

UNITED STATES

These woodpeckers thrive in forests that are “pyrodiverse,” a mosaic of areas burned at differing severities and juxtaposed with unburned areas. As fires become larger and more severe, these mosaics may be lost, diminishing habitat quality even for such a fire-loving species.

Mountain
bluebird
insect consumer

Northern flicker
insect consumer

Shared parenting
Both sexes of the black-backed
woodpecker incubate eggs
and tend their young.

Myotis bat
insect consumer

Flying squirrel
*seed and fungus
dispersal*

Black-backed
woodpecker
(female)

Squirrel
seed dispersal

Chickadee
insect consumer

Bumblebee
pollinator

Second homes
Other habitat-restoring
species live in former
woodpecker nests.

Chipmunk
seed dispersal

Afterlife of the forest
Once the birds leave, it can
take decades or more to know
if the forest will fully recover.

3

HOMESTEADING Annually

They excavate cavities to make new nests every year; chicks hatch in spring. Old nests shelter many small mammals and other birds.

4

MOVING AWAY 4-8 years

Black-backed woodpeckers leave for newly burned forests when fire-killed trees deteriorate and beetle populations diminish.

ROCK STEADY

Moab, Utah, draws 'moon walkers,' stargazers, and adventurers.

GETTING THE SHOT

This image of Andy Lewis silhouetted against a full moon took four months to make. "Even with every piece of technology we could get our hands on, it came down to going there, scouting, and seeing what lined up," says photographer Renan Ozturk, who aimed his camera from more than a mile away to frame the shot of Lewis on a slackline (a length of woven fabric that's suspended in the air). When the weather, people, and moon did eventually align, "we only had about a 30-second window to capture the moment."

NIGHT VISIONS

With three designated International Dark Sky Parks less than an hour's drive from Moab, those who can't see the Milky Way from their homes (a majority of Americans) can get their star fix there. At Arches and Canyonlands National Parks, and at Dead Horse Point State Park, visitors can gaze up at thousands of stars visible to the naked eye—compared with the few dozen, at most, visible from a big city. To help maintain these stellar views, Moab has strengthened its ordinances against light pollution.

DAYTIME MOVES

Surrounded by public lands featuring Jurassic-era sand dunes weathered into titian-tinted cliffs and spires, Moab lures adventurers and nature lovers who want to interact with the elements. Activities range from the mainstream (rafting, biking, hiking) to the extreme (slacklining, BASE jumping with parachutes or wingsuits). Parks in the area have also taken steps to make the outdoors more accessible for people with disabilities.

‘THE MORE TIME YOU
SPEND IN THESE DESERT
CANYONS, THE MORE YOU
FEEL THE PRESENCE OF
THE ANCIENT PUEBLOANS.’

—Renan Ozturk

BY THE NUMBERS

100

APPROXIMATE LENGTH, IN FEET,
OF THE SLACKLINE SHOWN HERE

300+

AGE OF OLDEST ROCK LAYERS,
IN MILLIONS OF YEARS, IN
CANYONLANDS NATIONAL PARK

2,000+

NUMBER OF ARCHES IN
ARCHES NATIONAL PARK



The moon sets
behind the rim
of a canyon in
Moab, Utah.

BY NORIE QUINTOS PHOTOGRAPH BY RENAN OZTURK

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PHOTO: ERLEND HAARBERG

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EXPLORE | DISCOVERY



FROM LETHAL TRAPS TO ARTFUL TREASURES

PHOTOGRAPHS BY ESTHER R

TWICE A MONTH, conservation biologist Mudumba, along with several of his colleagues, along with staff from the Uganda Wildlife Authority, pile into four-wheel drive vehicles on a rescue mission? To find and remove snares—widespread traps for wildlife—in northwestern Uganda’s Mudumbura Wildlife Park. Recent research suggests poachers set more snares per square mile in this park than anywhere else in the world. Most poachers here target antelope, but also hunt for meat, but elephants, giraffes, and other large mammals end up in the traps. Villages north of the park in Uganda, and many of the snares are set by people seeking protein-rich sustenance. Since 2015 Mudumba, a National Geographic Society employee, has taken part in snare-removal operations, training community members to transform recovered snares into sculptures of African wildlife. In addition to the sculptures, artisans, the employees earn an income from the sale of other types of food, as well as basic necessities. “It’s about alternative food sources [locals],” says Mudumba. The program employs 10 artisans and typically sells more than 800 sculptures, mainly through gift shops in the United States.

RAP SURE

RUTH MBABAZI

t Tutilo Mudumba and
ffers from the Uganda
-drive vehicles. Their
wire traps intended to kill
archison Falls National
s set more illegal snares
here else in the world.
buffalo, or warthogs for
animals also stumble
are among the poorest in
oy impoverished locals

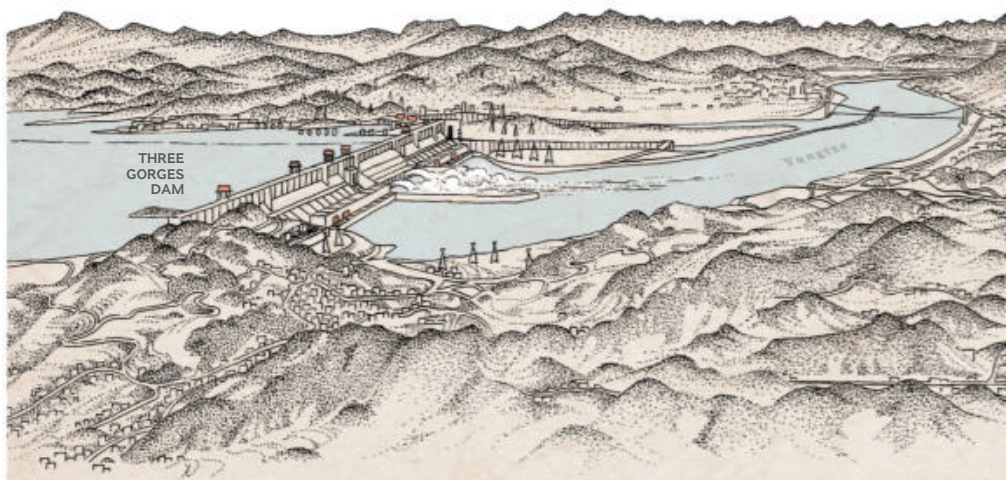
ographic explorer,
ions in the park as the
-profit engages commu-
nares into intricate
on to learning skills as
e that allows them to
ic needs such as medi-
es but also empowering
mploys some 600 arti-
culptures each month,
States. —JANI HALL



SNAGGING SNARES

During one five-hour search, a team can collect about 200 traps, which local artisans craft into sculptures of giraffes, hippos, and other wildlife that populate the park.

EXPLORE | ATLAS



SETTING RIVERS FREE

BY HEATHER GABRIEL SMITH AND CHRISTINA SHINTANI

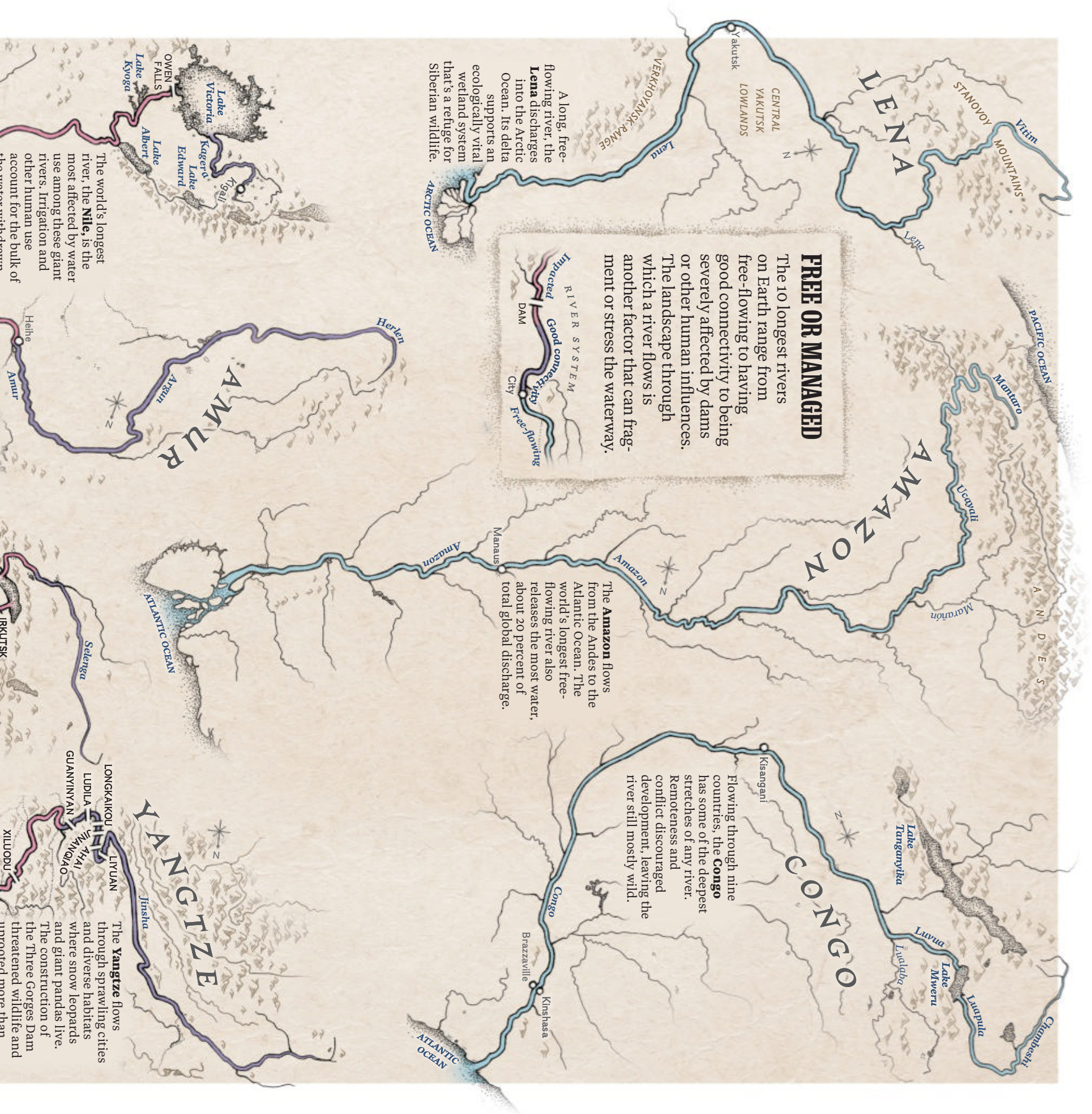
LONG, FREE-FLOWING RIVERS are increasingly rare. These serpentine giants should support entire ecosystems and allow the unobstructed movement of energy, materials, and wildlife in their waters and in the surrounding landscape. But humans have been harnessing their immense power for centuries, building so many dams and reservoirs, and so much other infrastructure, that now only 37 percent of the world's rivers

over a thousand kilometers long (621 miles) still run free. Human impacts include dams trapping sediment so that it can no longer naturally shape the river and deltas, and regulation of reservoir water levels to reduce flow to a trickle in some areas. Just how much these obstructions disrupt connectivity can vary throughout a river, but understanding their many consequences is crucial to restoring these ecosystems.





NOTE: DAMS ON THE UPPER YANGTZE WERE NOT INCLUDED IN THE ASSESSMENT. TED SICKLEY AND RYAN MORRIS. NGM STAFF. SOURCES: GUNTHER GRILL AND BERNHARD LEHNER, NATURE, MAY 2019; WALTER IMMERZEEL.



Hidden Narratives

BY JENNIFER BARGER AND HEATHER GREENWOOD DAVIS

O

AT LIVING HISTORY SITES, PEOPLE OF COLOR PORTRAY FIGURES FROM THE PAST, REVISITING PAINFUL ISSUES AND SHARING THEIR SIDES OF THE AMERICAN STORY.

ON HER DAYS OFF, New Yorker Cheyney McKnight might pull on leggings and a T-shirt or an African-print dress. But it takes a bit longer for her to get ready for her day job, when she dresses in a chemise, a corset, and three layers of petticoats topped by a cotton gown and a fabric head wrap.

McKnight is a 21st-century Black American, but the historical interpreter and founder of Not Your Momma's History specializes in portraying enslaved and free people during the 18th and 19th centuries in the United States. Drawing on almost a decade of work at living history sites including Virginia's Colonial Williamsburg, she might dress as an enslaved person to demonstrate hearth cooking at a Virginia plantation or depict a free Creole woman during a New Orleans history festival.

McKnight, like many interpreters, works in the third person, mimicking the garb of the past but not pretending to be a character from another time. She thinks this perspective allows her to speak more plainly and to put difficult issues like enslavement, racism, and torture into context.

"It can be difficult interacting with guests, but I want to meet the challenge," says McKnight. "My goal is to increase accurate portrayals of Black Americans at historic sites and museums."

In the U.S. most historical interpreters work at one of the nearly 200 living history museums across the country, from immersive places like Colonial Williamsburg to smaller sites, such as Civil War forts or grand Victorian-era estates.

Some historical interpreters are full-time employees, others part-timers or volunteers at special events. They do everything from conjuring well-heeled 1930s party guests on tours of California's



Adam Canaday, a journeyman coach driver at Colonial Williamsburg, stands next to his horse, Commodore. Canaday is one of the dozens of historical interpreters of color who work at the living history site in Virginia.

Hearst Castle to marching as 1880s soldiers at Michigan's Fort Mackinac.

These time-traveling guides and sites share a mission to educate visitors about history by immersing them in people, places, and activities. But institutions that employ—and try to honestly depict—Black, Indigenous, and other people of color still have a long way to go.

In the early 20th century, many historical sites glossed over people of color or simply left them out of their programming. Plantations might have had a costumed guide, but it was probably a white woman decked out as a *Gone With the Wind*-style lady of the manor. If the enslavement of people was alluded to, staffers might genteelly mention “servants.”

In the late 18th century, about half of the population of the city of Williamsburg was Black, burdened with the firewood chopping, bedpan emptying, and farming that kept the capital of the colony of Virginia humming. Colonial Williamsburg, a 301-acre open-air museum of early American life, was built in 1932 on the remnants of the old city. But in its early days, only a few costumed employees represented Black citizens, most of them dressed as coachmen.

When first-person interpretation started at Colonial Williamsburg in the late 1970s, three Black actors were among the troupe of nine people. They portrayed a range of enslaved characters, including the Reverend Gowan Pamphlet, a minister who was eventually freed. Today 36 first-person actor-interpreters are on staff; 15 are Black, though the total number of costumed interpreters of color on site is just 14 percent.

“We still haven’t found the sweet spot to make sure that the full story is told, but we’re further than we’ve ever been,” says Stephen Seals, who plays enslaved

American Revolution spy James Armistead Lafayette.

Historian and actress Mary Carter began portraying Aggy, a real-life 18th-century enslaved Black woman, at Colonial Williamsburg in 2011, drawn by her unexpectedly nuanced biography. Like many enslaved women, Aggy was impregnated by the plantation owner, Ryland Randolph, and bore him two children. More unusual: When Randolph died, his will stipulated that Aggy and her children be freed. It would take a battle in courts to enforce his wishes. “I wanted people to know her name and to know her story,” says Carter.

In tours and talks, Carter veers into disturbing topics like consent, violence, and human rights. As Aggy, Carter is wary and speaks with hesitation, conveying the cornered nervousness of someone whose time, words, and movements are not her own. The questions visitors pepper her with—“Did Randolph love her? Was he good to her?”—demand hard-to-hear answers. “I understand what they’re asking: They want to know if there was hope or a silver lining,” says Carter. “I think enslaved people did find moments of joy, but it’s wrong to look for them in the actions of people who held them in bondage.”

Like most interpreters, Carter continues her research—through letters, court documents, and diaries. Her portrayal of Aggy is ever evolving. “There have been times in my own life I was made to feel ashamed because I was a descendant of enslaved people,” she says. “But they forgot to tell me to be proud of what they endured, what they survived, what their strength caused them to push through.” □

Jennifer Barger is a senior editor and **Heather Greenwood Davis** a contributing editor at National Geographic.



Tourists walk down Duke of Gloucester Street, the main road at Colonial Williamsburg, which closed briefly last year because of the pandemic. More than 600 original and reproduced structures evoke the onetime capital of the Virginia colony.

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NEIL DEGRASSE TYSON
with JAMES TREFIL

COSMIC QUERIES

StarTalk's Guide to Who We Are,
How We Got Here, and Where We're Going

UNLOCK THE SECRETS OF THE COSMOS

NEIL DEGRASSE TYSON,

a renowned physicist and science popularizer, is taking on the big questions that humanity has been posing for millennia—How did life begin? What is our place in the universe? Are we alone?—with wit, wisdom, and cutting-edge science.



This relatable and entertaining book will engage and inspire readers of all ages, bring sophisticated concepts within reach, and offer a window into the complexities of the cosmos.

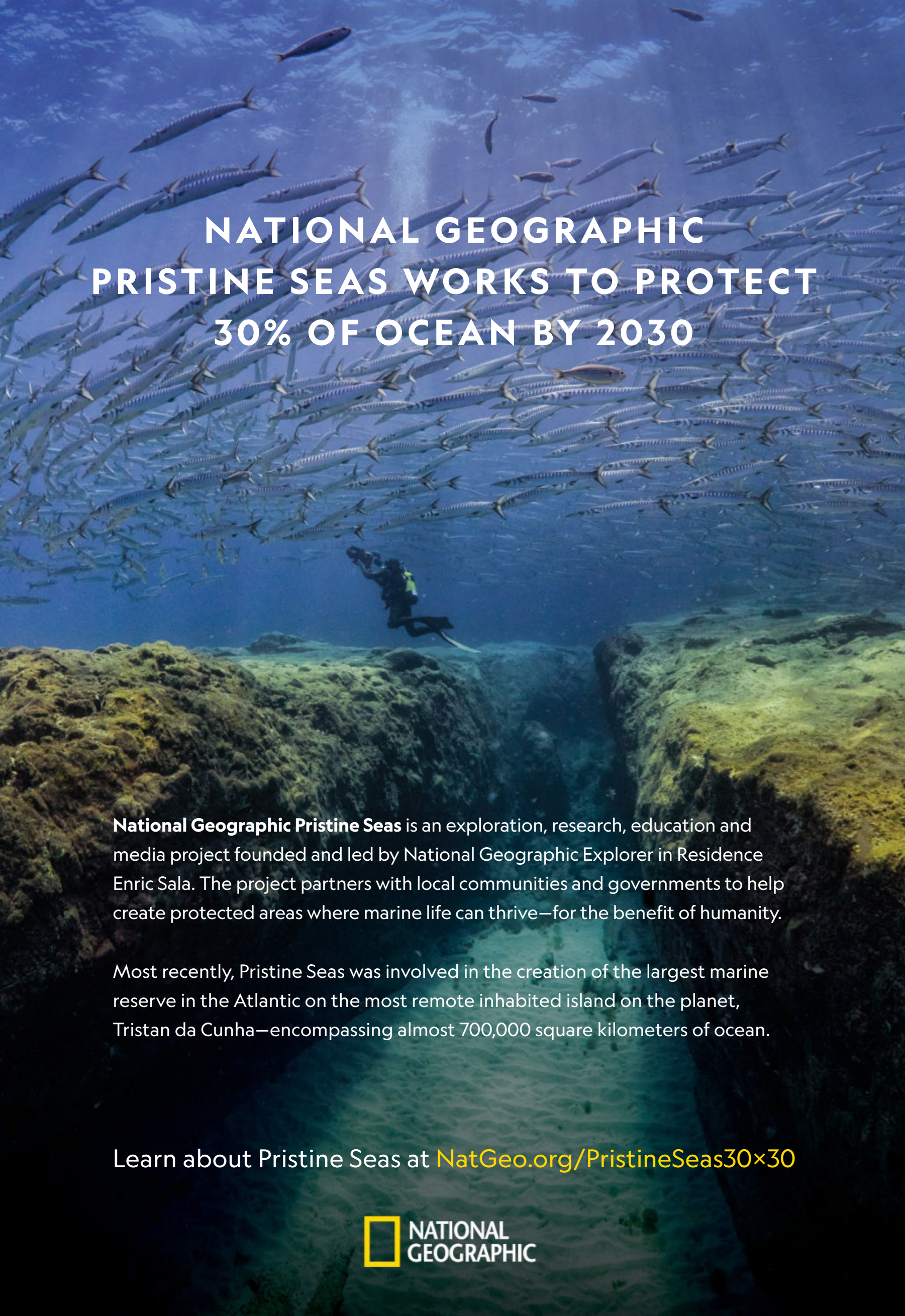
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NATIONAL
GEOGRAPHIC

A large school of silver fish, possibly barracudas, swims in clear blue water. Below them, a diver is visible near a rocky seabed covered in green algae. The text is overlaid on the upper half of the image.

NATIONAL GEOGRAPHIC PRISTINE SEAS WORKS TO PROTECT 30% OF OCEAN BY 2030

National Geographic Pristine Seas is an exploration, research, education and media project founded and led by National Geographic Explorer in Residence Enric Sala. The project partners with local communities and governments to help create protected areas where marine life can thrive—for the benefit of humanity.

Most recently, Pristine Seas was involved in the creation of the largest marine reserve in the Atlantic on the most remote inhabited island on the planet, Tristan da Cunha—encompassing almost 700,000 square kilometers of ocean.

Learn about Pristine Seas at [NatGeo.org/PristineSeas30x30](https://www.natgeo.org/pristine-seas-30x30)



Fascinating Mars P. 38
Off Death Row P. 66
The Battles for the
Siachen Glacier..... P. 94
Dog Racing Decline... P. 122

FEATURES



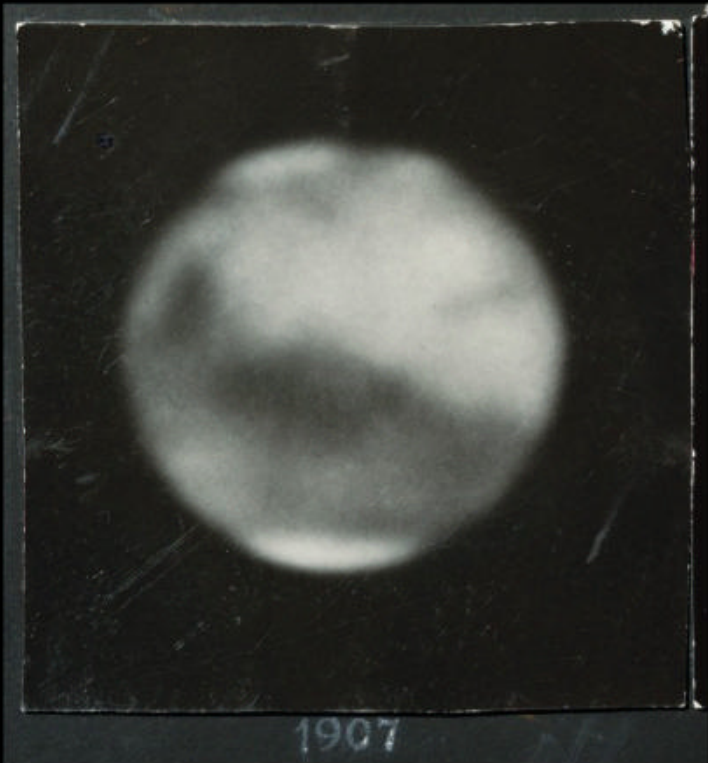
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94

‘FOR DECADES, INDIA AND PAKISTAN
HAVE SENT YOUNG SOLDIERS
TO THIS HARSH ENVIRONMENT,
WHERE THEY REMAIN FOR MONTHS
AT A TIME, GUARDING A REMOTE,
UNINHABITED WILDERNESS.’

BY NADIA DRAKE
PHOTOGRAPHS BY CRAIG CUTLER AND SPENCER LOWELL

Our
Obsession
With
MARS

THE DUSTY RED PLANET HAS FASCINATED US
FOR CENTURIES. EVEN AS WE LEARN MORE, ITS
MYSTERIES KEEP US IN SUSPENSE.



Then and Now

Early, blurry views of Mars inspired stories of canal-building aliens. While intelligent

civilizations never flourished there, rovers such as Curiosity (right) now drive the search for microbial Martians.

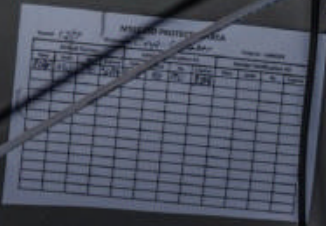
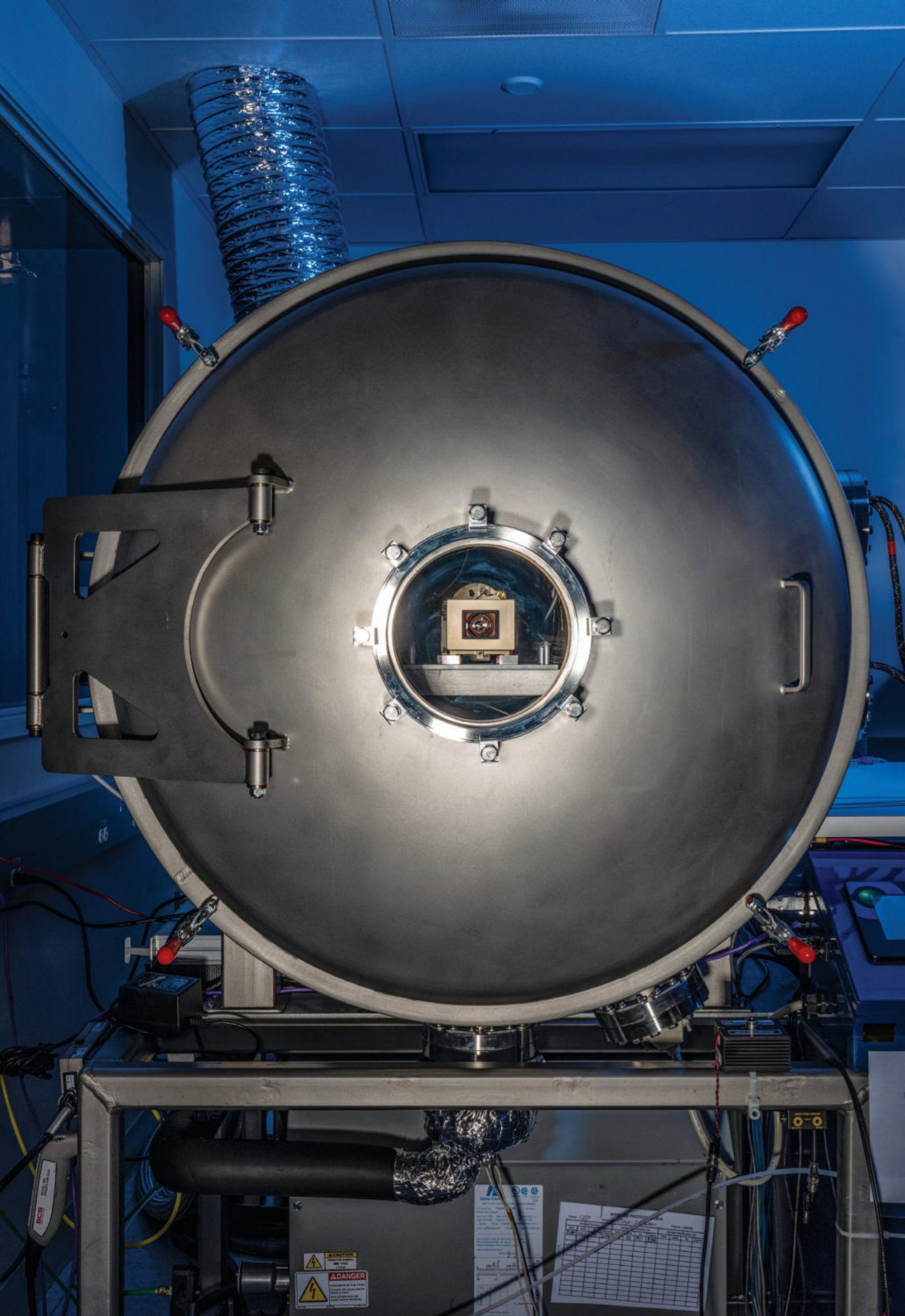




Assembling Mastcam-Z

Flight assembly technician Olawale Oluwo of Malin Space Science Systems in San Diego, California, holds part of Mastcam-Z, a pair of cameras with zoom capabilities installed on NASA's Perseverance rover. A Mastcam-Z camera is tested in a chamber (right) that simulates the planet's wide swings in surface temperature.

CRAIG CUTLER (BOTH)



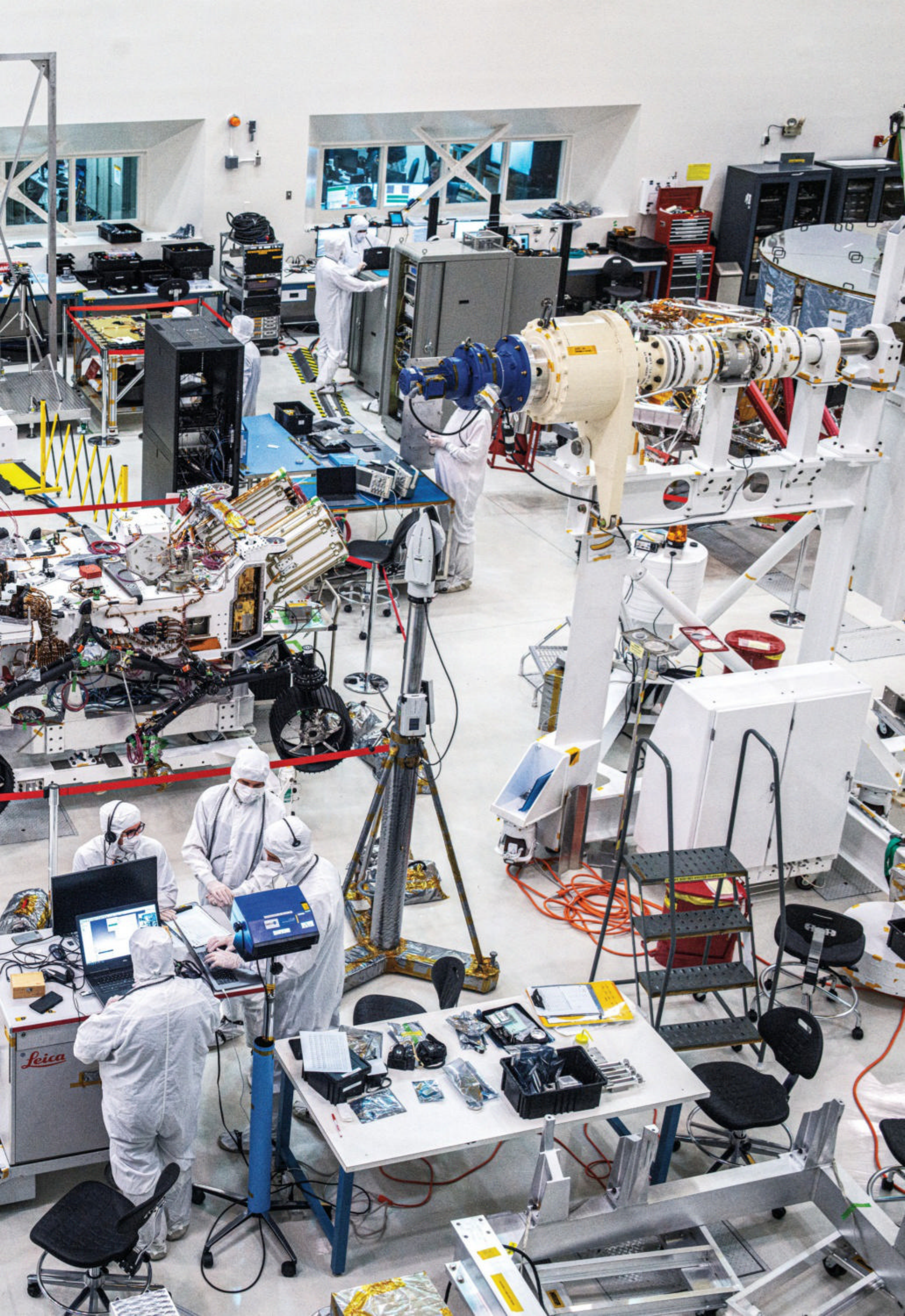
Eight spacecraft are operating in orbit around Mars or exploring its dusty surface. In February 2021, as of press time, three more robotic emissaries are scheduled to rendezvous with the red planet, including the flagship NASA rover, Perseverance.

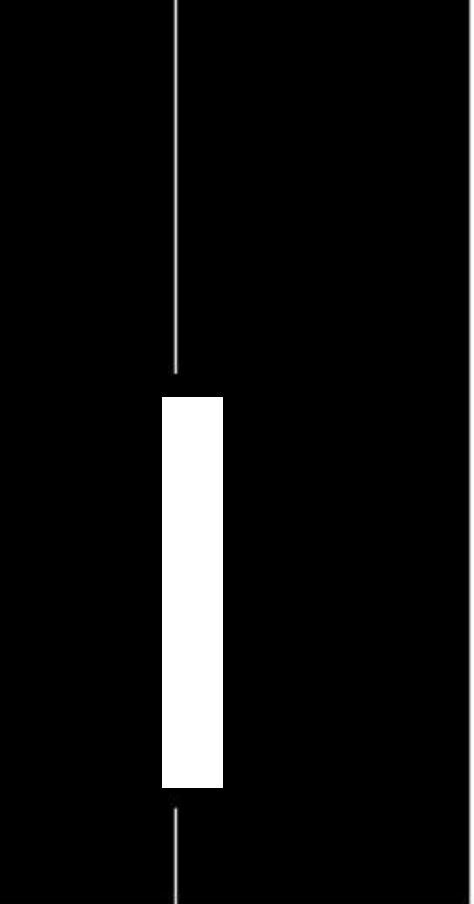
A Clean Start

Engineers at NASA's Jet Propulsion Laboratory in Pasadena, California, work in a sterile room to calibrate the Perseverance rover's 23 cameras before launch. Given the rover's goal of looking for signs of life on Mars, technicians took many precautions to avoid contaminating the machine with Earth-based microbes.

SPENCER LOWELL





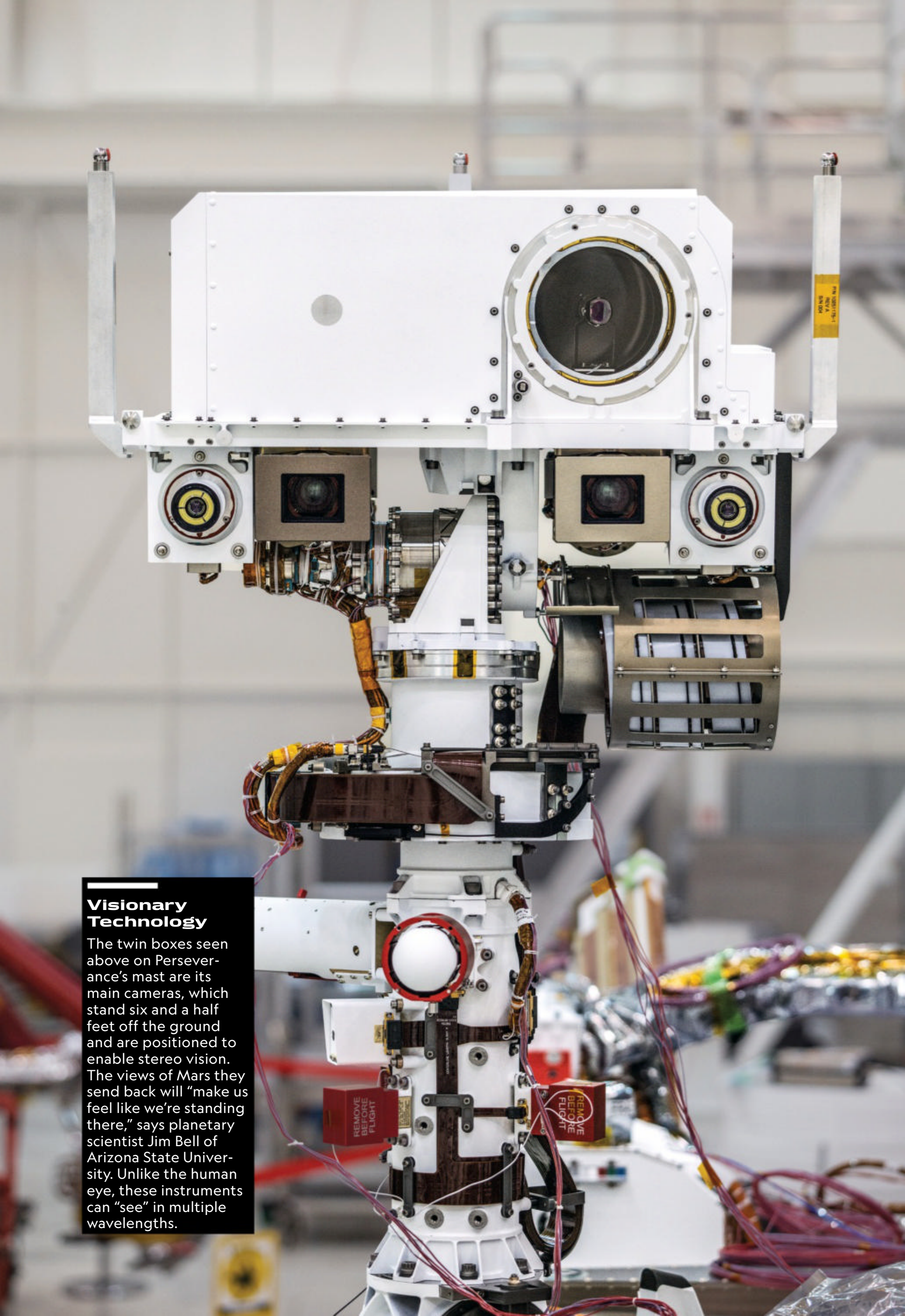


It's a warm night in mid-October, and I'm winding my way up to the University of Virginia's McCormick Observatory on a quest to solve an abiding mystery: Why are Earthlings so dang obsessed with Mars?

The observatory's hilltop dome is open, etching a glowing amber crescent into the autumn darkness. Inside stands a telescope that will help me see Mars as it appeared to observers more than a century ago, when eager astronomers used this instrument in 1877 to confirm the discovery of the two tiny Martian moons, Phobos and Deimos.

Tonight UVA astronomer Ed Murphy has made a special trip up to the observatory, which is closed to the public because of the ongoing coronavirus pandemic. The whirling dance of orbital dynamics has put Mars at its biggest and brightest in the sky right now, and Murphy calculated that this would be the best time to see it from central Virginia, where the turbulent air can sometimes complicate nighttime sky-gazing.

He climbs up a ladder and settles onto the viewing platform, a wooden perch constructed in 1885,



Visionary Technology

The twin boxes seen above on Perseverance's mast are its main cameras, which stand six and a half feet off the ground and are positioned to enable stereo vision. The views of Mars they send back will "make us feel like we're standing there," says planetary scientist Jim Bell of Arizona State University. Unlike the human eye, these instruments can "see" in multiple wavelengths.

Rolling in the Deep

Getting a spacecraft to Mars is not easy, and many early missions failed. But in 1997 NASA's Pathfinder mission successfully landed and released Sojourner, the first wheeled rover on the planet. This pioneering robot has a supporting role in the 2015 film *The Martian*.



NASA/JPL

and nudges the giant telescope toward the conspicuous orange dot of light. He fiddles with a knob, bringing the planet into focus. “Wait for those few moments when the atmosphere settles down, and you’ll actually see Mars looking crisp and clear ... and then it will all get blurry again,” he says through his space-themed face mask.

We swap places. Through the telescope, Mars is an upside-down, peach-pink sphere that swims in and out of resolution. I hesitantly sketch its shadowy features during fleeting moments of clarity, doing my best to channel the 19th-century scholars who once charted its landscapes, some fervently believing that its alien face bore the markings of an advanced civilization.

Today we know there are no immense engineering scars crisscrossing the planet’s vermilion surface. But that doesn’t really matter. Human

interest in Mars is ageless. For millennia we’ve made sense of Mars by attaching our deities to it, charting its motion, and mapping its face. We’ve worked Mars into our art, our songs, our literature, our cinema. Since the beginning of the space age, we’ve also hurled more than 50 pieces of hardware—engineering marvels that collectively cost billions of dollars—at Mars. Many, especially early on, have failed. And still our Mars mania marches on.

As I meet with Murphy in October, eight spacecraft are operating in orbit around Mars or exploring its dusty surface. In February 2021, as of press time, three more robotic emissaries are scheduled to rendezvous with the red planet, including a flagship life-seeking NASA rover called Perseverance and two potentially history-making missions from China and the United Arab Emirates.

But, why? Among the worlds we know, Mars is not superlative in any way. It’s not the brightest, the closest, the smallest, or even the easiest to get to. It’s not as mysterious as Venus; not as spectacularly adorned as jewel-toned Jupiter or ringed Saturn. It’s arguably not even the most likely place to find extraterrestrial life—that would be the icy ocean moons of the outer solar system.

“A bunch of red dirt on Mars is not as interesting as some of these other worlds,” says Paul Byrne, a planetary scientist at North Carolina State University. “I don’t advocate for a second that we shouldn’t be exploring it. I do advocate, loudly, that we should be considering how Mars fits into the overall space exploration strategy.”

The scientific reasons why Mars is a compelling target are complex and evolving, propelled by a cornucopia of images and information from all those orbiters, landers, and rovers. Mars is a perpetual enigma, a place we’re always on the cusp of knowing but don’t truly understand. “This is one of the world’s longest unfolding discoveries,” says Kathryn Denning, a York University anthropologist specializing in the human elements of space exploration. “It’s this giant exercise in suspense.”

And the reason Mars remains lodged in the popular zeitgeist might be witheringly simple: Even as our picture of it has sharpened over time, we can still easily envision ourselves there, building a new home beyond the confines of Earth. “It’s just blank enough,” Denning says.

With a sloppy sketch of Mars in my hand, I think of the decades we’ve spent chasing little

green men, and microbes, and human settlements, and how Mars fervor has returned after every setback. At the same time, I know plenty of scientists are ready to heap our dreams—and our robots—onto other inviting destinations across the solar system. As scientists juggle limited resources and increasing competition, I can't help but wonder if we'll ever shake ourselves loose from the allure of Mars.

SINCE CIVILIZATIONS first gazed skyward, humans have followed Mars and charted its capricious path through the heavens. As the Sumerians tracked this “wandering star” crossing the sky in the third millennium B.C.E., they noted its foreboding color and associated it with the malevolent deity Nergal, god of pestilence and war. Its movements and varying brightness portended the deaths of kings and horses or the fates of crops and battles.

Aboriginal cultures also note its color, describing it as something that has been burned in flames or linking it to Kogolongo, the native red-tailed black cockatoo. The pre-Columbian Maya carefully plotted the object's position relative to the stars, tying its movements to shifting terrestrial seasons. The Greeks associated it with Ares, after their god of war, whom the Romans recast as Mars.

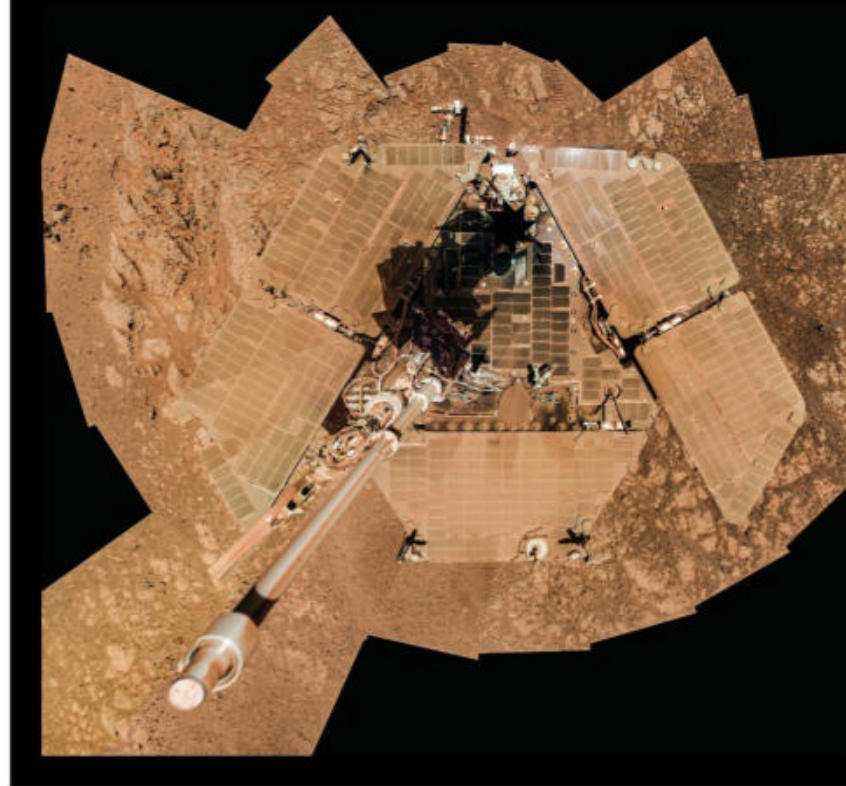
“There was always only one actual planet Mars, but there are a lot of different cultural Mares in play,” Denning says.

By the mid-1800s, telescopes had transformed Mars from a mythological figure into a world. As it came into focus, Mars became a planet with weather, shifting terrains, and ice caps like Earth's. “The very first time we had a way to look at Mars through the eyepiece, we started discovering things that were changing,” says the SETI Institute's Nathalie Cabrol, who has studied Mars for decades. With more advanced instruments, this dynamic place could be studied—and mapped.

During the Victorian era, astronomers sketched the Martian surface and presented their drawings as fact, although the whims and biases of the mapmakers influenced their final products. In 1877 one of those maps captured international attention. As drawn by the Italian astronomer Giovanni Schiaparelli, Mars had harshly delineated topography, with islands that erupted from dozens of canals, which he colored blue. Schiaparelli stuffed his map with

The View From Above

Pictures from NASA's Mars rovers not only advance science, they also can endear the robots to the public. In 2014 the Opportunity rover sent back this selfie, made of multiple combined images. It showed the rover's solar panels coated with sun-blocking dust.



MOSAIC IMAGE BY NASA/JPL/CORNELL UNIVERSITY/ARIZONA STATE UNIVERSITY

detail, and instead of conforming to contemporary naming conventions, he labeled the exotic features on his version of the planet after places in Mediterranean mythologies.

“That was a really massively bold statement to make,” says Maria Lane, a historical geographer at the University of New Mexico. “It's basically him saying, I saw so much stuff that was so different from what anyone else had seen, I can't even use the same names.”

As a result, Lane says, Schiaparelli's map was instantly authoritative. Scientific and popular opinion pronounced it a powerful representation of truth. Three decades of unconstrained Mars mania followed, and by the end, any reasonable person would be forgiven for believing intelligent Martians had built a planet-spanning network of canals. Much of that *Continued on page 56*

SCIENCE PERSEVERES

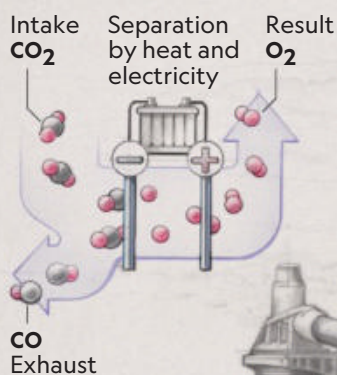
The COVID-19 pandemic hit as NASA scientists and engineers were readying their newest Mars rover for liftoff. The aptly named Perseverance conquered its first challenge by launching last July, on target for landing in February 2021. The rover's mission was planned for at least one Martian year—or 687 days, as humans calculate time on Earth.

FAR-FLUNG LAB

Big daily temperature swings and rocky terrain make for tough working conditions. To survive, this rover's body is based on past vehicles but with newly designed wheels, more brainpower, and a stronger arm.

MOXIE: The Oxygenator

Future human visits might be possible if this technology test can produce oxygen molecules from Mars's carbon dioxide-rich atmosphere.

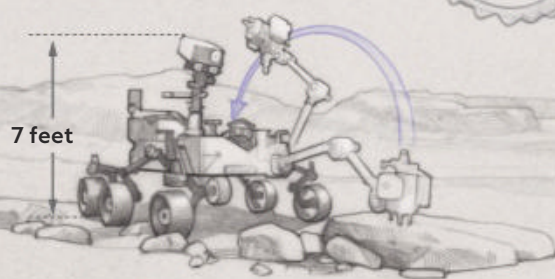


RIMFAX: The Revealer

Radar waves reaching 30 feet deep will reveal what's under the surface; 3D modeling will help identify intriguing finds, such as ice or water.

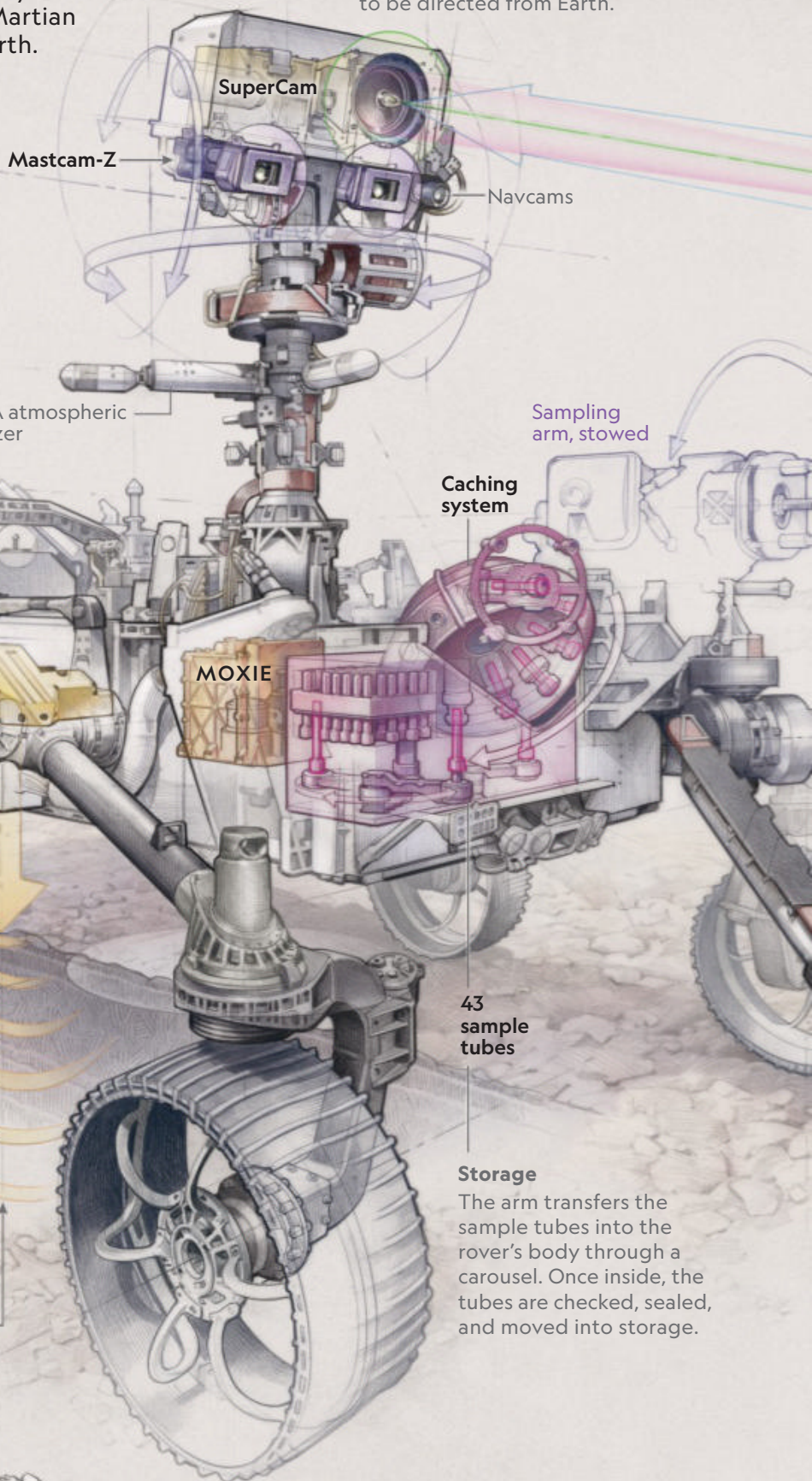
RETRIEVE AND RETURN

Rolling along at a top speed of 0.1 miles an hour, the 2,260-pound rover will collect rocky samples from Jezero crater for eventual return to secure laboratories on Earth.



A CLEAR VIEW

Mastcam-Z assesses Mars's geology and atmosphere. The Navcams allow the rover to be directed from Earth.



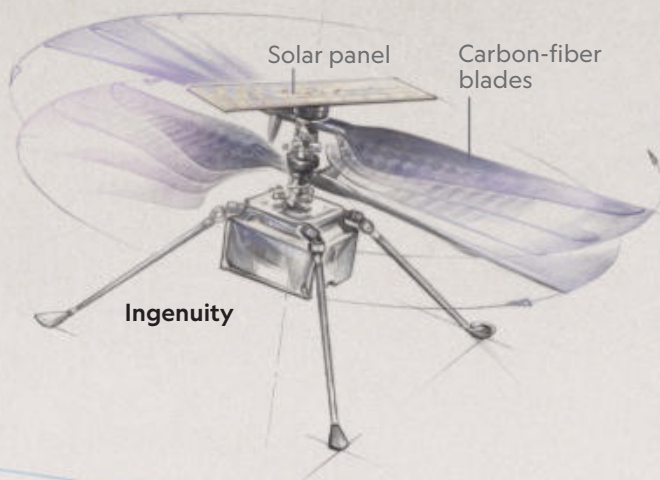
Storage

The arm transfers the sample tubes into the rover's body through a carousel. Once inside, the tubes are checked, sealed, and moved into storage.

Collected samples will be deposited at a well-documented site on the surface to await retrieval years later.

COLLECT 2021-2023

DEPOSIT



Ingenuity

TEST FLIGHT

Ingenuity, a small helicopter, will test if vehicles can fly in Mars's thin atmosphere.

Earth Entry Vehicle
2031

The return capsule will detach from the orbiter to enter Earth's atmosphere.

DATA
RETURN

LASER
BEAM

SAMPLING ARM

A heavy rotating turret on a flexible, seven-foot-long arm holds instruments to analyze rocks for traces of past life and a drill to collect samples.

SHERLOC: The Prospector

Magnifying cameras and lasers detect and map minerals that might be useful samples to collect.

Laser scan

SuperCam's lasers vaporize rock and reflect back information about its composition and chemical makeup.

SAMPLE TUBE
ACTUAL SIZE

Earth
Return
Orbiter

Sample
return
capsule

Mars
Ascent
Vehicle

The rocket settles into low orbit and releases the sample container to the Earth Return Orbiter for the trip home.

Sample
Return
Lander

PIXL: The Detector

Working in the dark of night, x-ray fluorescence can pick up the chemical traces of potential fossils.

WATSON
magnifying
camera

SHERLOC

UV laser
scanner

Coring drill

Cylinders of solid rock and surface material are collected in sterile tubes.

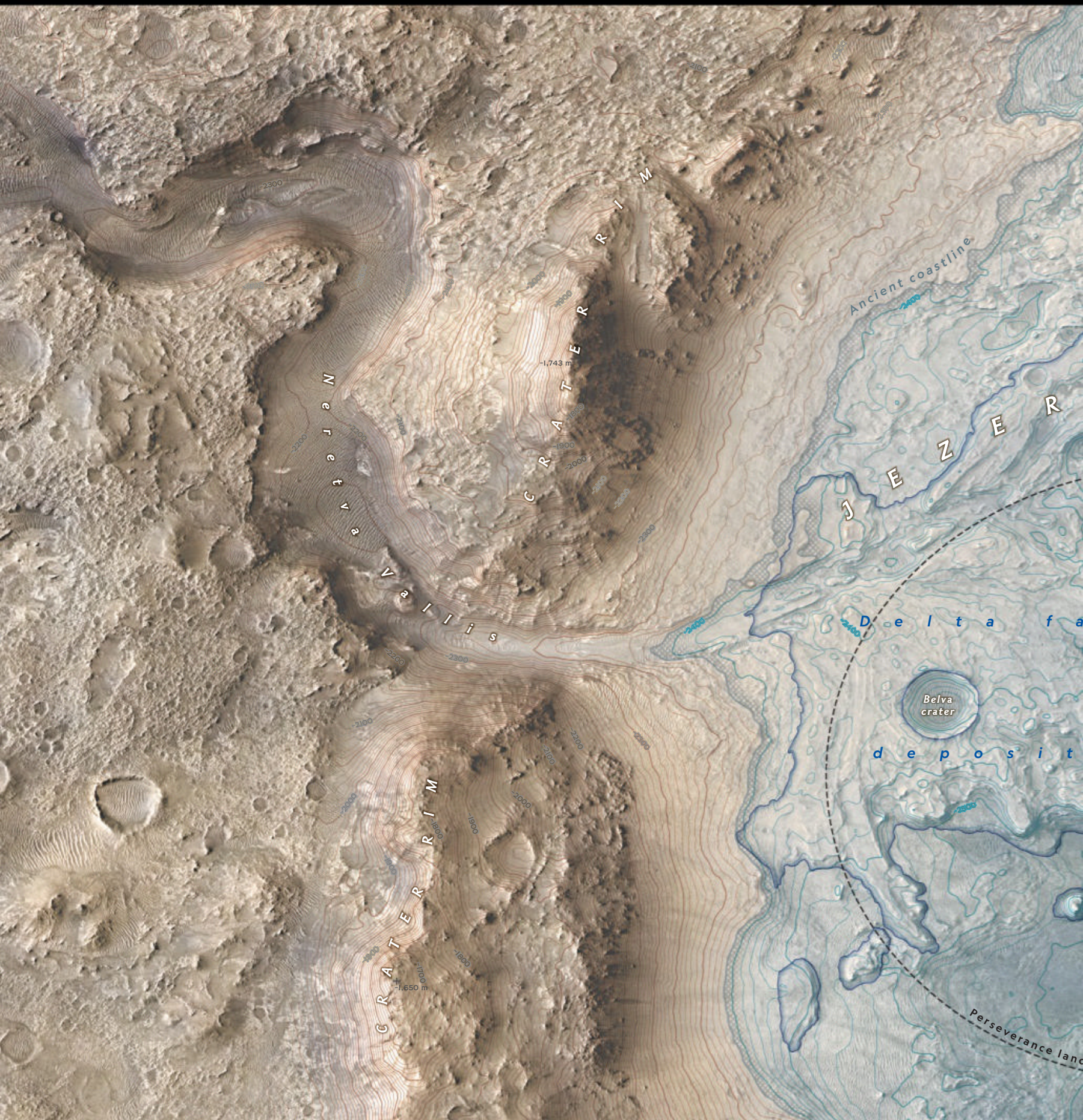
Rock
sample

Sample
Tube

The European Space Agency's solar-powered Sample Fetch Rover will collect the filled tubes and drive them to a NASA lander.

Sample
Fetch Rover

An arm on the lander will transfer the tubes into a container that will be rocketed into orbit on the Mars Ascent Vehicle.





LAKES OF A BYGONE ERA

Geologists are looking for tell-tale patterns that ancient bodies of water leave on rocks and minerals. Erosion at the edges of a lake leaves beach sands and wave-cut terraces, while certain clays and hydrated minerals can form or be deposited only in the presence of water.

MOVING UP THE DELTA

Perseverance will use its suite of scientific instruments to plumb the mysteries of how the delta formed at Jezero crater and to see whether fossilized microbes might be trapped in its layers of sediments.

HEADED FOR THE PLAINS

Slated to land on the flat surface of the crater floor, Perseverance eventually will climb up the channels of the delta into the river valley—then on to the plains beyond.

SIGNATURE OF FLOW

Ancient river deltas on Mars formed much as they do on Earth. Fast-flowing water meets standing water, depositing bits of sand, minerals, and silt eroded from the surrounding valley. Scientists hope sediments collected from Jezero crater might hold traces of life that washed into the basin.

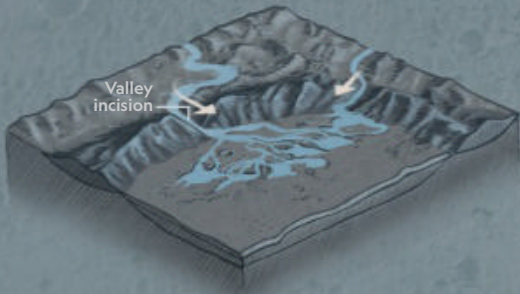
COSMIC COLLISION

A meteorite formed the 28-mile-wide Jezero crater some four billion years ago. Over time, the crater filled with volcanic debris.



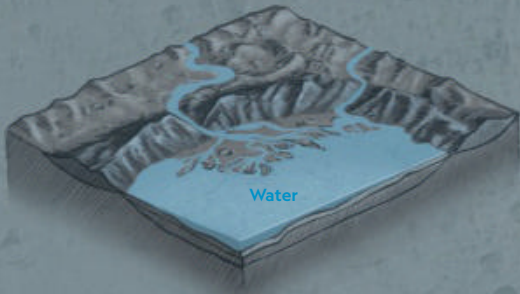
WATER FILLS THE CRATER

Roughly half a billion years later, during Mars's wet era, two flowing channels broke through the crater's rim, creating a lake inside the basin.



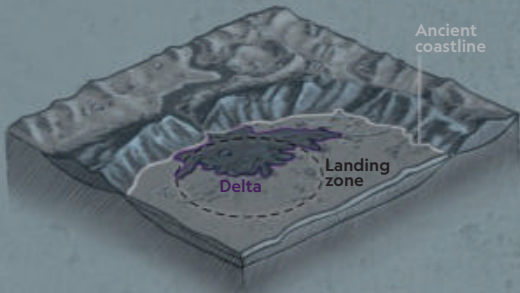
MINERALS ACCUMULATE

Moving water continued to deposit materials at the basin's edge, forming a delta lined with sediments washed in from afar.



MARS DRIES UP

Liquid water and much of the ice disappeared from the red planet 3.5 billion years ago, leaving behind a dried lake bed at Jezero. The remaining delta has shrunk over time from wind erosion.

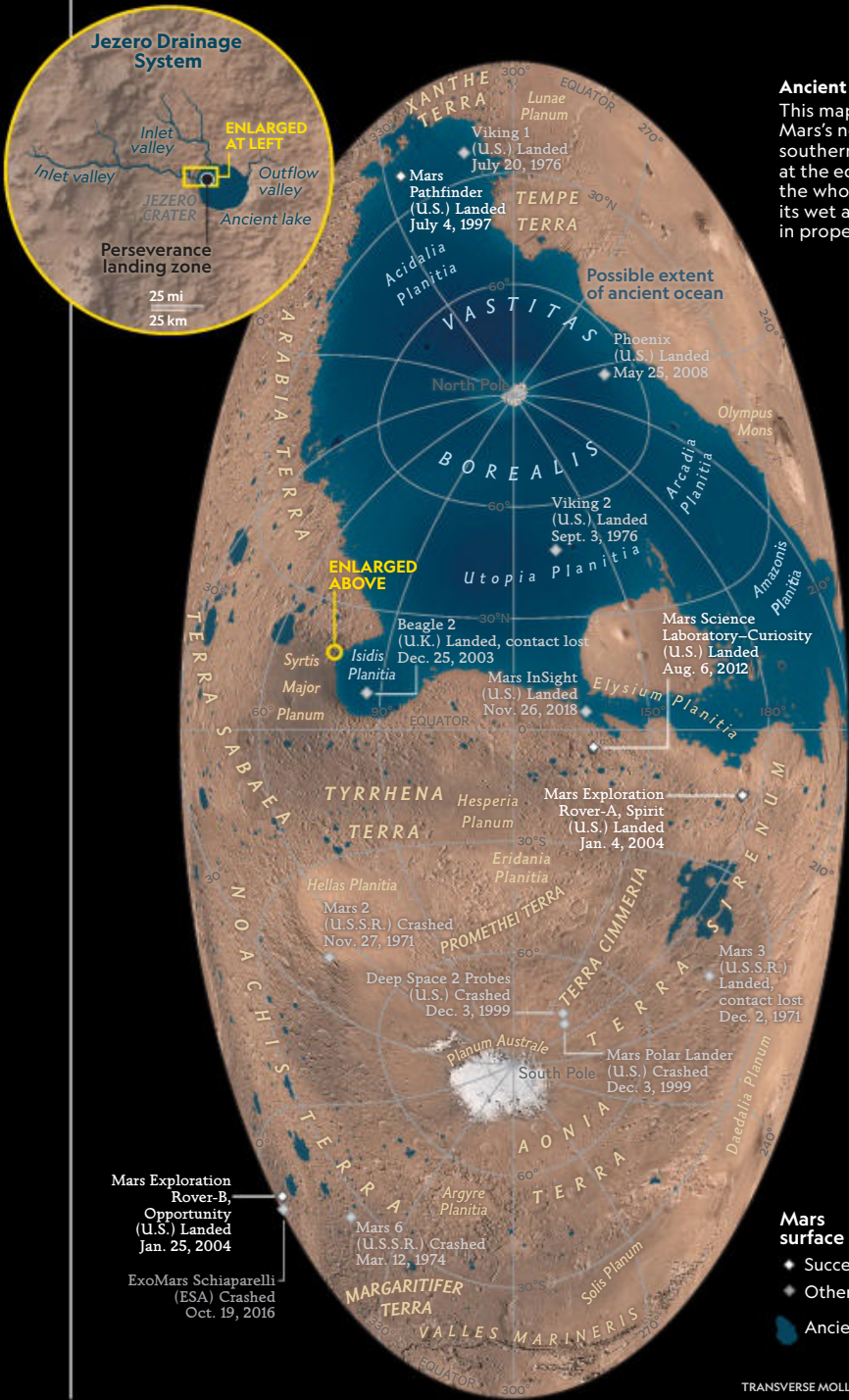


MATTHEW W. CHWASTYK AND MANUEL CANALES, NGM STAFF
ALEXANDER STEGMAIER. CRATER TIME LINE ART: MATTHEW TWOMBLY
SOURCES: USGS ASTROGEOLOGY RESEARCH CENTER; NASA; TIMOTHY A. GOUDGE,
UNIVERSITY OF TEXAS AT AUSTIN; BRIONY HORGAN, PURDUE UNIVERSITY

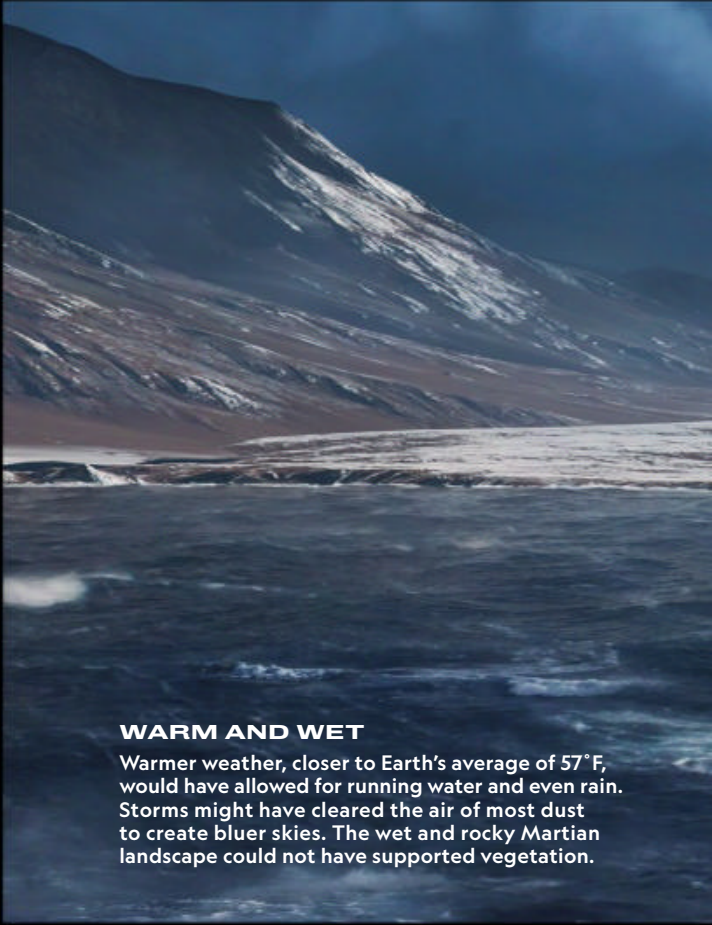
* WITH THE ABSENCE OF SEA LEVEL, HEIGHTS ON MARS ARE CALIBRATED TO THE ALTITUDE WHERE WATER COULD EXIST AS LIQUID, A SOLID, OR A GAS. THIS ELEVATION ON THE PLANET'S SURFACE IS DESIGNATED AS ZERO AND PLACES THAT ARE LOWER ARE EXPRESSED AS NEGATIVE NUMBERS.

IMPRINTS OF A WATERY PAST

Early visions of alien-made canals turned out to be fantasy, but Mars does boast geologic features such as river channels and deltas that hint at a wet history. Now, after more than 40 years of exploration, scientists have a deeper understanding of the planet's surface—and how parts of the landscape were transformed by flowing water some three and a half billion years ago.



Ancient ocean
This map stretches Mars's northern and southern hemispheres at the equator to show the whole planet and its wet and dry areas in proper proportion.



WARM AND WET
Warmer weather, closer to Earth's average of 57°F, would have allowed for running water and even rain. Storms might have cleared the air of most dust to create bluer skies. The wet and rocky Martian landscape could not have supported vegetation.



COLD AND ICY
Temperatures colder than Antarctica would have kept any surface water frozen, with ice and snow at high elevations. Volcanic lava and steam might have briefly warmed some regions. Ancient Mars would have appeared more gray; today oxidized iron gives its soil a ruddy hue.



ANCIENT HORIZONS

In 2003 a rover found evidence that water once flowed on Mars, but early climatic conditions on the red planet are still up for debate. Models suggest two extremes that would have allowed some liquid to exist on the surface, illustrated here; scientists suspect Mars may have cycled between both states.



MANUEL CANALES AND MATTHEW W. CHWASTYK, NGM STAFF; ALEXANDER STEGMAIER. ART: ANTOINE COLLIGNON
SOURCES: ASHLEY PALUMBO, BROWN UNIVERSITY; ROBIN WORDSWORTH, HARVARD UNIVERSITY; NASA

Continued from page 47 fervor can be linked directly to Percival Lowell, a quirky aristocrat with a serious Mars obsession.

A WEALTHY BOSTONIAN and Harvard University alum, Lowell had more than a passing interest in astronomy, and he was an avid reader of scientific and popular texts. Inspired in part by Schiaparelli's maps, and believing that alien technology had crafted the Martian canals, Lowell raced to build a hilltop observatory before the autumn of 1894, when Mars would make a close approach to Earth and its fully sunlit face would be prime for observing those supposed canals.

With the help of some friends and his family fortune, the Lowell Observatory emerged that year near Flagstaff, Arizona, on a steep bluff that the locals named Mars Hill. From there, among the conifers, he dutifully studied the red planet, waiting night after night for the shimmering world to come into focus. Based on his observations and sketches, Lowell not only thought he could confirm Schiaparelli's maps, he believed he spotted an additional 116 canals. "The more you look through the eyepiece, the more you're going to start seeing straight lines," Cabrol says. "Because this is what the human brain does."

In Lowell's estimation, the Martian canal builders were supremely intelligent beings capable of planetary-scale engineering—an alien race intent on surviving a devastating change in climate that forced them to build mammoth irrigation canals stretching from the poles to the equator. Lowell published his observations prodigiously, and his conviction was infectious. Even Nikola Tesla, the electric pioneer who famously sparred with rival inventor Thomas Edison, got caught up in the moment and reported detecting radio signals coming from Mars in the early 1900s.

But Lowell's story began to fall apart in 1907, in part because of a project he funded. That year, astronomers took thousands of photos of Mars through a telescope and shared them with the world. Planetary photography eventually replaced cartography as "truth," Lane says. Once people could see for themselves how the photos and maps of Mars didn't match, they no longer bought into the authority of Lowell's maps.

Still, by the turn of the 20th century, Mars had become a familiar neighbor with changing landscapes and the lingering promise of inhabitants. The next wave of observations revealed



CRAIG CUTLER

that seasonally, the Martian polar caps shrank and expanded, unleashing a swath of darkness that crawled toward the equator. Some scientists in the 1950s thought those shadowy areas had to be vegetation that flourished and died back, theories that made it into top-tier journals. All this scientific fervor fueled a trove of speculative fiction, from H.G. Wells's *War of the Worlds* and Edgar Rice Burroughs's *Barsoom* serials to Ray Bradbury's *Martian Chronicles*.

"In the days before we'd really explored Mars, pre-1960s, there was just a wealth of imagination," says Andy Weir, author of *The Martian*. "A science fiction author could say, I don't know anything about Mars, so I can say whatever I want about Mars."

Then, in 1965, NASA's Mariner 4 probe swept



In Command From Afar

Angela Magee of Malin Space Science Systems works on instructions for a camera on Curiosity, which landed on Mars in 2012. For now, the Martian surface is a place humans can explore only remotely. Scientists must program command sequences to tell their robotic avatars what to do, where to go, and which hazards to avoid.

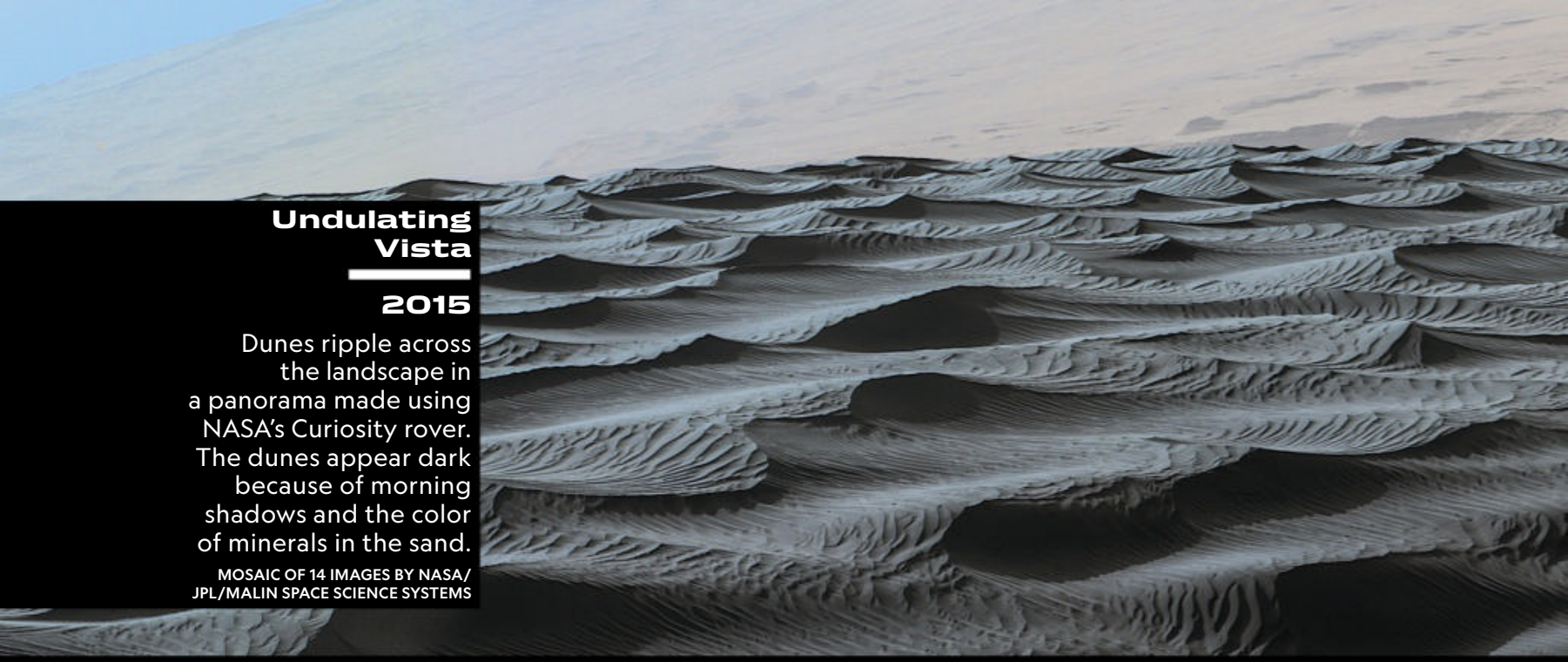
by the red planet. It captured the first close-up images of the Martian surface in black and white, transforming the rich pop culture playground into a grainy, cratered landscape. Seen at last, the planet's arid sterility was a stark disappointment. But it didn't take long for the idea of life on Mars to rekindle in human imaginations.

IN A SENSE, the isolation of the COVID-19 pandemic has given me a feel for what workdays must be like for Mars scientists. I usually travel extensively, getting my notebooks dirty as I chase stories across deserts, sweltering jungles, and sea ice. Currently, Mars explorers spend their lives trying to understand a place that will come into focus only through a lens or on a computer screen. They won't soon plunge

a glove into its alien soil or brush dust from their visored faces; remotely guided rovers must do the work instead.

On a Tuesday morning in October, I've turned on videoconferencing to talk to the SETI Institute's Cabrol, who is across the continent in California. Instead of a bookshelf, artfully arranged, she has a vision of Mars as her backdrop. It's an expansive vista, with dark, boulder-strewn peaks straddling rusty plains and distant ridgelines in the orange haze. That's fitting, I think, for a scientist who's spent decades immersing herself indirectly in Martian landscapes.

Then Cabrol shifts. Tire treads, trucks, and a cluster of bright orange tents appear in the foreground. Instead of staring at Mars, I'm seeing an image of one of Cabrol's field sites in the Chilean



Undulating Vista

2015

Dunes ripple across the landscape in a panorama made using NASA's Curiosity rover. The dunes appear dark because of morning shadows and the color of minerals in the sand.

MOSAIC OF 14 IMAGES BY NASA/
JPL/MALIN SPACE SCIENCE SYSTEMS



A Rocky Expanse

2016

This 360-degree panorama captures the eerily Earthlike quality of a Martian midafternoon in Gale crater, the Curiosity rover's landing site.

MOSAIC OF 138 IMAGES BY NASA/
JPL/MALIN SPACE SCIENCE SYSTEMS

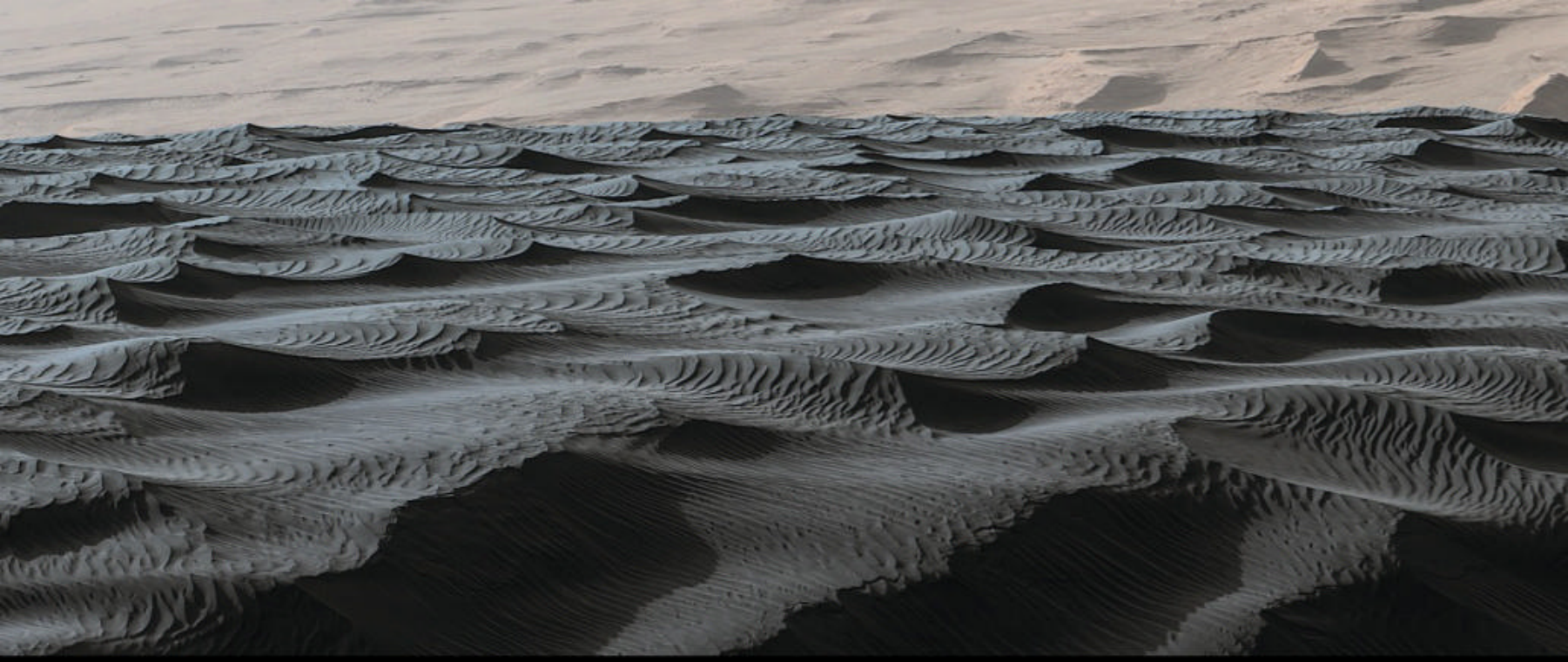


Getting Sharper

2019

The Curiosity team made this high-resolution panorama from the side of Mount Sharp, a mound inside Gale crater, by assembling more than a thousand images taken over four days.

MOSAIC OF 1,139 IMAGES BY NASA/JPL/
MALIN SPACE SCIENCE SYSTEMS



Altiplano. For decades she has scoured this high desert for Mars-like environments, looking for life on volcanic peaks and in high lakes and trying to imagine how a robotic avatar might accomplish the same task, tens of millions of miles away.

Cabrol and other modern scientists focused on Mars owe a debt to Mariner 9, the first spacecraft to orbit Mars in 1971. At first, Mariner couldn't see through a massive planetwide dust storm. "Mars was still trying, until the last minute, to keep a veil of mystery," Cabrol says. But as the sand settled, the camera spied the summits of the humongous Tharsis Montes, a trio of volcanoes dwarfed only by neighboring Olympus Mons. To the east was mammoth Valles Marineris, a rift valley that resembles Arizona's Grand Canyon, only nine times longer.

Most importantly, in the thousands of photographs taken by Mariner 9, scientists saw ancient river-carved valleys, floodplains, channels, and deltas. They also picked up chemical clues of water ice. These were all signs that flowing water once sculpted exotic Martian landscapes.

"The geologic evidence is overwhelming that the climate was very different than it is today," says Ramses Ramirez, who studies the ancient Martian climate at the Earth-Life Science Institute in Tokyo, Japan. That realization changed the course of Mars exploration. "It was so much more profound than all the folklore we could have in mind," Cabrol says, "and another adventure started. The scientific one."

Knowing that ancient Mars may have been a somewhat Earthlike abode ignited a new set of questions in planetary evolution, and it reinvigorated interest in finding out whether life may have once existed on Mars or, with luck, still did. "I think it's fascinating that we're still dealing with the same themes as Percival Lowell would recognize," says Rich Zurek, chief scientist of the Mars Program Office at NASA's Jet Propulsion Laboratory (JPL). "Just ... no canals."

NASA quickly followed Mariner 9 with an even more ambitious mission. In 1976 humans finally were able to gaze at the red planet from eye level when the twin Viking landers touched down in the northern hemisphere. By that time, scientists already knew vegetation didn't seasonally carpet Mars; those shifting shadows were the work of dust storms whipping up volcanic sand. They also already knew that water didn't flow abundantly over its surface anymore.

But they didn't know whether the planet's

soils were devoid of life, and at least one astronomer—Carl Sagan—wasn't ready to completely abandon the idea of even larger life-forms.

Just in case Martians were nocturnal, "for a long time, we had a very high-intensity lamp planned to be on Viking so that we could take pictures at night," recalls Gentry Lee, a science fiction author and chief engineer at JPL. To Sagan's disappointment, the Viking team decided to remove the lamp from both landers, and if you had pressed Sagan about whether he truly expected to see Martians wandering by he'd probably demur, Lee says.

The Viking experiments found no Martian microbes and no footprints in the sand. Instead, they unveiled hints of perchlorates in the soil, compounds that can destroy organic molecules and potentially erase any traces of carbon-based life. "So, you couldn't even look for the bodies, if you will," Zurek says.

But Viking did send back images of ruddy, rock-strewn plains that looked like they could have been snapped from any arid place on Earth. New views of Mars kept flooding in, as NASA landed rover after rover on the planet's desolate surface: Pathfinder in 1997, then the twin Spirit and Opportunity rovers in 2004, followed by the Curiosity rover in 2012. Each vehicle arrived outfitted with increasingly sophisticated cameras, and together they sent back roughly 700,000 images. Now when we see those rover tracks in the soil or we see the robot selfies showing them perched on a colorful crater rim, we can more easily imagine ourselves in their treads.

"Once you land, there's this whole evocation of what it means to be a human in this place," says Yale University anthropologist Lisa Messeri, who studies how space-based imagery affects our perception of worlds.

ABOUT AN EIGHT-HOUR DRIVE from Istanbul, Lake Salda in southwest Turkey is a local haven. Dark volcanic rocks tumble toward the brilliant white sandy beach ringing the shore. Clear aquamarine waters become a deep abyssal blue near the lake's center, where the bottom is hundreds of feet down. It's an almost perfect modern analog for Jezero crater, the spot where NASA's Perseverance rover is targeting its search for signs of ancient life.

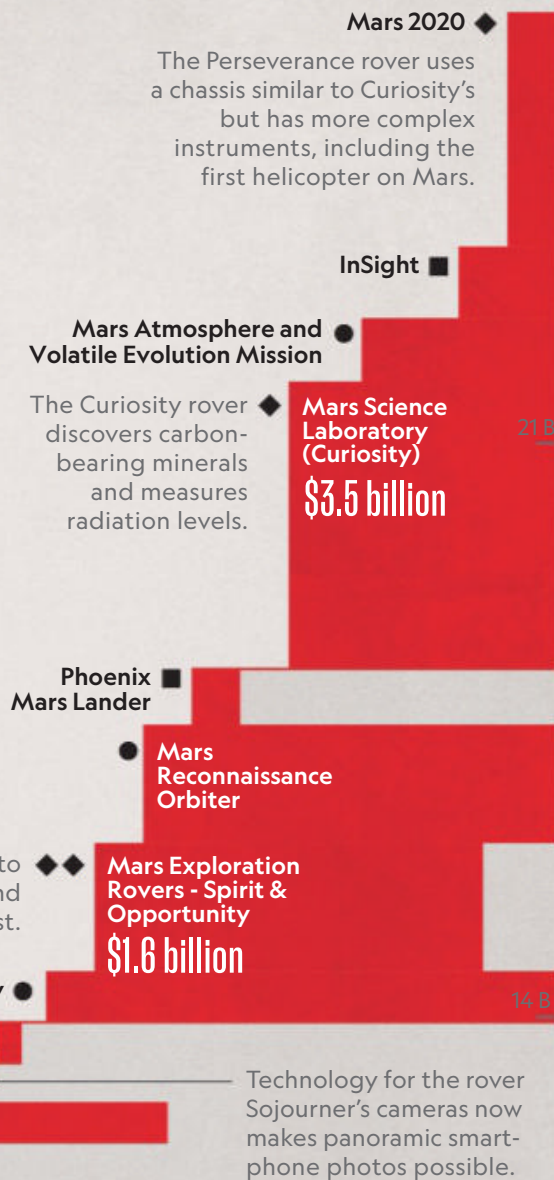
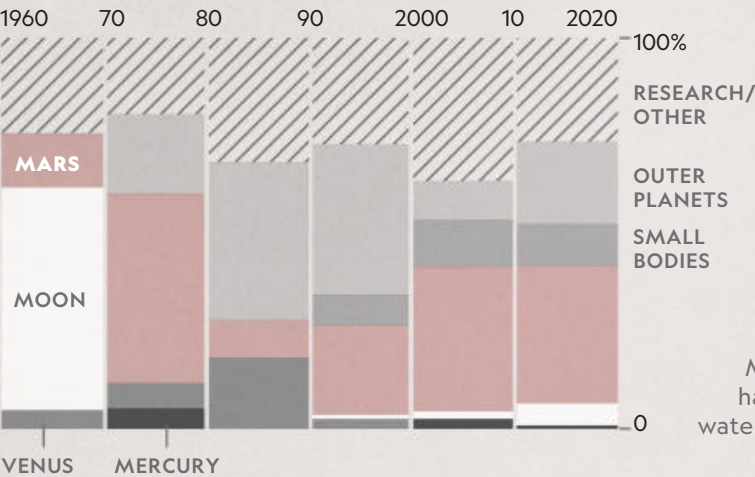
"The locals call it the Maldives of Turkey," says Brad Garczynski, a graduate student in planetary science at Purdue University who traveled to the

COSMIC BUDGETING

People are fascinated by two big questions about Mars: Did life ever exist on the red planet, and could humans survive there now? Satisfying our curiosity takes time and resources. But mission by mission, with ever larger investments of capital, NASA and its partners are using past successes and failures as scaffolding for the next big leaps.

CHANGING FOCUS

Since the 1960s NASA's planetary science budget has reflected priorities beyond the moon. Mars's share has grown, but total investment in the planet since then has been less than 2 percent of NASA's total spending.



\$26.2 Billion

IN MARS MISSIONS

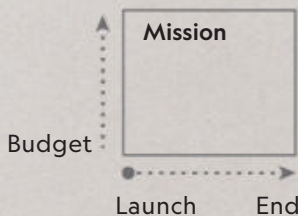
Getting to Mars is a challenge. The Soviets saw nearly all their missions fail; more recently, Russia's, Japan's, and China's missions failed. But India and Europe have active Mars orbiters, and NASA's success rate is more than 70 percent.

COSTS INCLUDE LAUNCHES AND ARE ADJUSTED FOR INFLATION TO 2019 DOLLARS.

Mission spacecraft

✕ Flyby ■ Lander ● Orbiter ◆ Rover

Outlined symbols represent failed missions



site in 2019. “You could imagine yourself as a little microbe tanning yourself on the shoreline of Jezero.”

It’s dry now, but the sculpted terrain suggests that Jezero once was filled with a deep, large crater lake fed by flowing rivers. More than 3.5 billion years ago, water likely rushed into Jezero from the north and west, depositing layers of sediments in fanning deltas near the crater walls. Over time, the crater filled and flooded, eventually sending water back out through a breach to the east.

From orbit, spacecraft have identified clays and carbonate minerals near Jezero’s deltas that require water to form. Lake Salda’s white sands similarly are made of busted-up carbonates called microbialites, rocky structures made when dissolved carbon dioxide forms carbonate ions that react with other elements, such as magnesium, and precipitate rapidly, trapping organic compounds. On Earth this process forms layered structures that preserve the oldest evidence of terrestrial microbial life, dating back 3.5 billion years. Scientists are hoping that Jezero’s carbonates did the same, and that they trapped anything that once inhabited the lake or its ancient shores.

“It’s one of the reasons we’re excited about Jezero crater,” says Purdue University planetary scientist Briony Horgan. It’s also why Garczynski is practicing being a Mars rover in Turkey: He’s looking for the most likely places for bio-signatures to be preserved, and he’s figuring out what they’d look like to Perseverance. To do that, he collected nearly a hundred pounds of samples from Lake Salda and flew them home in a suitcase.

Like Garczynski, Perseverance will be collecting rocks for a return trip, although maybe just 450 grams, at most. As the rover wheels around Jezero, its onboard cameras—which see Mars in multiple wavelengths—will help it identify the most tantalizing rocks to collect. The rover will cache those samples and leave them on Mars, where they’ll wait for a ride home on a future spacecraft. Once they arrive in Earth-based laboratories, scientists will use the best possible instruments to read the record of Mars’s ancient climate and tease out any possible signs of life.

Or maybe, with luck, Perseverance’s advanced cameras will be the first to glimpse evidence of fossilized Martians.

IF ANYTHING, though, Mars has taught humankind that we often fall prey to wishful thinking

Martian Field Test

Successfully operating a rover on Mars takes lots of practice; here on Earth, scientists use locations that mimic Martian terrains to work out various kinks in their procedures. In February 2020 a dry lake bed in Nevada stood in for Mars as JPL researchers Raymond Francis (standing) and Marshall Trautman worked with remote camera operators to test equipment designed for the Perseverance rover.



about life on its surface. From canals to vegetation to hotly debated hints of fossils in Mars meteorites, the red planet repeatedly has paved over our hopes with bleak, barren realities. So why, then, are we sending yet another spacecraft to look for life on Mars—not even for organisms that are alive today but for traces of organisms that may have flourished billions of years ago?

“We. Haven’t. Looked. For. Life. On. Mars,” Cabrol asserts, getting animated. “If you don’t have a good understanding of the environment, how are you going to be able to decrypt or extract a life signal out of that?!” Even Viking, she says, which was purportedly a life-finding mission, carried an experiment that was designed without enough knowledge of the Martian environment to reasonably succeed.



SAM MOLLEUR, NASA/JPL

But those ancient landscapes are still there, preserving a record of the planet's infancy and a time when life could have thrived in a slightly wetter period, blanketed by a thicker atmosphere.

"We know the canals don't exist, we know there is no pyramid on Mars, no alien civilization, no Tupperware," Cabrol says. But if we do find that some prebiotic chemistry littered the Martian surface, we may learn something about how life evolves on any rocky shores—including our own.

What if Perseverance finds no evidence for Martian fossils or even signs that places like Jezero could have been inhabited? Will we ever be able to give up on the idea of life on Mars? Probably not, admits David Grinspoon, senior scientist at the Planetary Science Institute. "It's very hard to kill the idea that Mars is somehow hiding life

from us," he says. "It's very, very tenacious."

In a way, that stubbornness is perhaps the most blatant manifestation of our desire for companionship, a longing for communion, a need to know that we are not alone in the universe. Humans, for the most part, need other humans to survive, and maybe that's true on a planetary scale as well.

"We are not a solitary people," Weir says. "At a macroscopic level, we—humanity—we don't want to be alone." □

Contributing writer **Nadia Drake** last wrote for *National Geographic* about how spaceflight changes the way astronauts think about Earth. California-based photographers **Craig Cutler** and **Spencer Lowell** enjoy bringing complex science stories to life.

WE JUST CAN'T GET

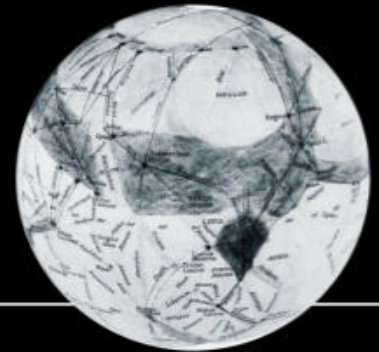


1570s "Mars and Venus United by Love"
A joining of opposites: Cupid uses a special love knot to bind the Roman god Mars to the goddess Venus in a painting by Paolo Veronese.



1898 *The War of the Worlds*
A witness recounts an epic battle between Martians and Earthlings in H.G. Wells's now notorious thriller.

CHRONICLE/ALAMY
STOCK PHOTO



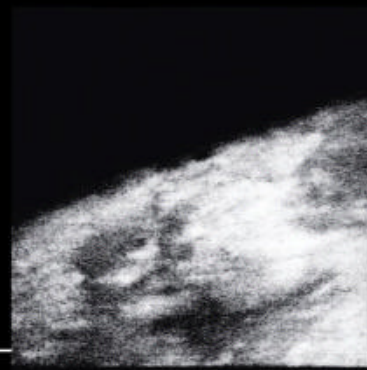
1906 Lowell's Canals
As he drew on his maps (above) and described in a 1906 book, Percival Lowell believed Mars was a dying world covered in irrigation canals.

LOWELL OBSERVATORY
ARCHIVES



PAINTING BY DOUGLAS S. CHAFFEE,
NATIONAL GEOGRAPHIC IMAGE COLLECTION

1967 Sagan's Vision
For *National Geographic*, Carl Sagan imagined radiation-resistant Martians shielded by glassy shells, eating cabbage-like plants that fold up at night.



1965 Mariner 4
When this spacecraft flew by Mars, it snapped images of a planet that looked disappointingly like the moon: cratered and sterile, without any signs of alien life.

NASA

1976 Mars Vikings
NASA's Viking mission included two orbiters and two landers, the first to take high-resolution images of Mars from its desolate surface.

NASA



1996 *Mars Attacks!*
Directed by Tim Burton, this film poked fun at 1950s science fiction movies. In it, murderous Martians terrorize Earth until they're defeated by a country song.

PICTORIAL PRESS LTD/ALAMY
STOCK PHOTO



ENOUGH OF MARS



1918 *A Trip to Mars*
Like many early 20th-century depictions, this Danish silent film focused on Mars's supposed inhabitants—in this case, benevolent vegetarians.

PICTORIAL PRESS LTD/ALAMY STOCK PHOTO



1939 "The Man From Mars"
Drawn by Frank R. Paul for *Fantastic Adventures*, this Martian is telepathic and can retract his eyes and nose to protect them from freezing.

CHRONICLE/ALAMY STOCK PHOTO



1954 Full Color
Astronomer E.C. Slipher took this image from South Africa; he published his *Photographic Story of Mars* (1905-1961) in 1962.

E.C. SLIPHER, LOWELL OBSERVATORY ARCHIVES

1951 *Flight to Mars*
In this sci-fi drama, scientists arrive on Mars to find a planet populated by a subterranean, dying race similar to humans—who may be plotting a desperate invasion of Earth.

PICTORIAL PRESS LTD/ALAMY STOCK PHOTO



2015 *The Martian*
In Andy Weir's futuristic survival tale, astronaut Mark Watney, played by Matt Damon, is abandoned on Mars after crewmates mistake him for dead.



GENRE FILMS/INTERNATIONAL TRADERS/MID ATLANTIC FILMS/20TH CENTURY/ALBUM, ALAMY STOCK PHOTO

2019 *Starship*
If SpaceX CEO Elon Musk has his way, a version of the retro-looking launch vehicle seen here being built in Texas will one day shuttle humans to the moon, Mars, and beyond.

LOREN ELLIOTT, GETTY IMAGES



Since 1973,
more than 8,700
people in the
U.S. have been
sentenced to
death. More
than 1,500 have
been executed.

182 of those sent to death row actually were **INNOCENT**

These are stories of justice gone wrong.



Albert Burrell,
13 years on
death row

Derrick Jamison

SENTENCED IN
HAMILTON
COUNTY, OH

20 YEARS IN PRISON,
ALL ON DEATH ROW;
EXONERATED IN 2005

Derrick Jamison was arrested for the 1984 robbery and murder of a Cincinnati bartender. He was convicted based on false testimony from one of the real perpetrators of the crime, who testified against Jamison in exchange for a lesser sentence. He was scheduled for execution six times but each time received a stay, the last one 90 minutes before he was to die. In 2000 a judge ordered a new trial. His conviction was overturned, and all charges were dismissed in 2005. Jamison, now 60, educates others about the flaws of the U.S. justice system and encourages changes to it.

PREVIOUS PHOTO

Albert Burrell

UNION COUNTY, LA

13 YEARS IN PRISON,
ALL ON DEATH ROW;
EXONERATED IN 2001

Burrell, now 66, came within 17 days of his scheduled execution in Louisiana before his attorneys won a stay in 1996. His conviction for first-degree murder in a double homicide was overturned. He was granted a new trial after a judge ruled that prosecutors had misled the jury and failed to turn over exculpatory evidence. After the state concluded that no credible evidence linked Burrell to the murders, he was released.





Ron Keine

BERNALILLO
COUNTY, NM

2 YEARS IN PRISON.
ALL ON DEATH ROW;
EXONERATED IN 1976

Ron Keine, center, 73, was one of four men wrongfully convicted and sentenced to death for the kidnapping, rape, and murder of a University of New Mexico student in 1974.

The *Detroit News* found that prosecutors coerced testimony from a key witness, a motel housekeeper who later recanted her statement. Keine was released after a murder weapon was traced to a drifter who admitted to the killing. A prosecutor was disbarred and three detectives were fired because of their actions.





A 63-year-old man named Kwame Ajamu lives walking distance from my house in a suburb of Cleveland, Ohio. Ajamu was sentenced to death in 1975 for the murder of Harold Franks, a money order salesman on Cleveland's east side. Ajamu was 17 when he was convicted.

AJAMU, THEN NAMED Ronnie Bridgeman, was found guilty primarily because of the testimony of a 13-year-old boy, who said he saw Bridgeman and another young male violently attack the salesman on a city street corner. Not a shred of evidence, forensic or physical, connected Bridgeman to the slaying. He had no prior criminal record. Another witness testified that Bridgeman was not on the street corner when Franks was killed. Yet mere months after his arrest, the high school junior was condemned to die.

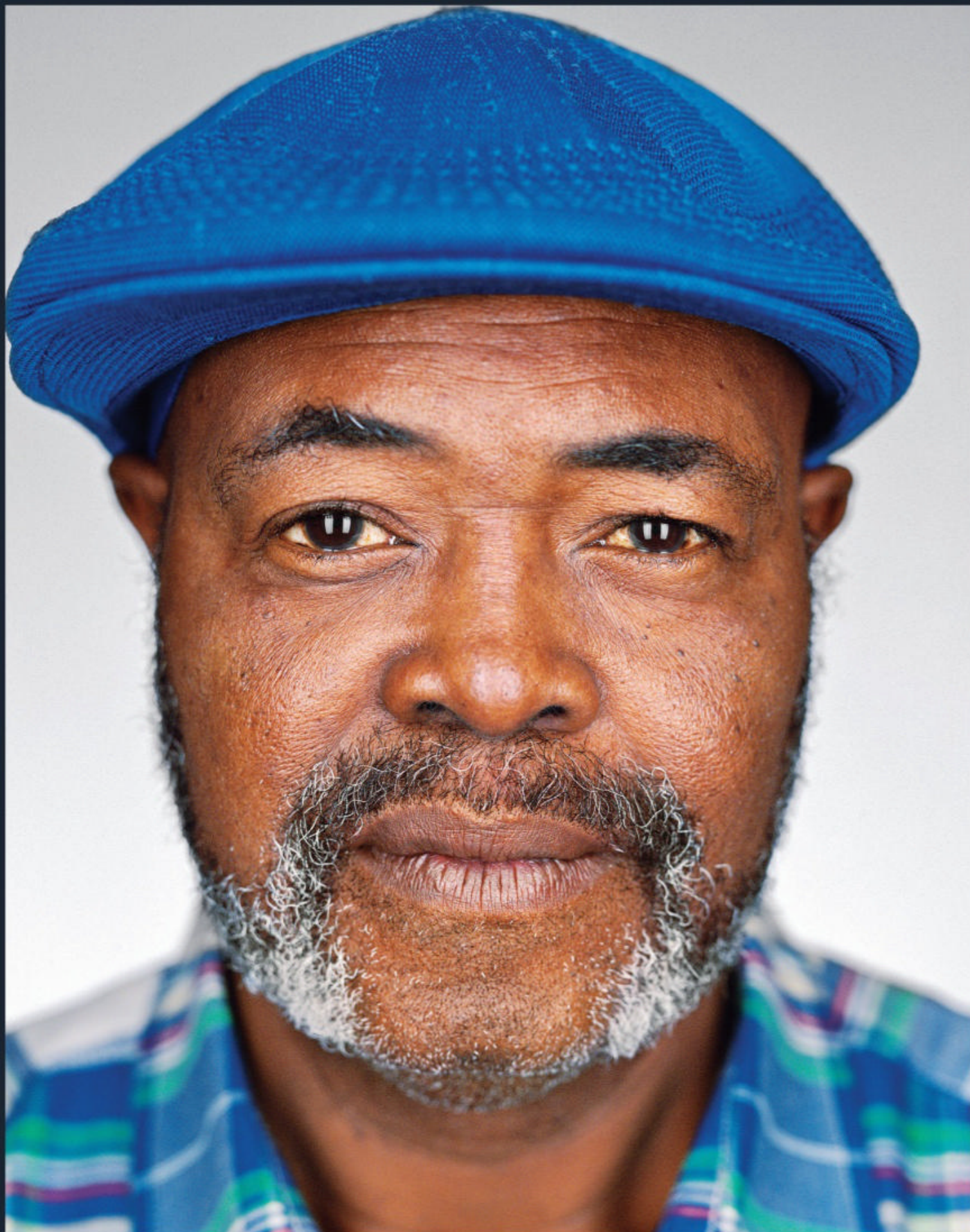
It would be publicly revealed 39 years later that the boy who testified against him had immediately tried to recant his statement. But Cleveland homicide detectives told the boy they would arrest and charge his parents with perjury if he changed his story, according to his later court testimony. Ajamu was released on parole in 2003 after 27 years in prison, but the state of Ohio would not declare him innocent of the murder for nearly another 12 years, when the boy's false statement and police misconduct were revealed in a related court hearing.

I interviewed Ajamu and others who represent vastly different backgrounds but share a similar, soul-crushing burden: They were sentenced to death after being convicted of crimes they didn't commit.

The daily paths they travel as former death-row inmates are every bit as daunting, terrifying, and confusing as the burden of innocence that once taunted them. The post-traumatic stress faced by a wrongly convicted person who has awaited execution by the government doesn't dissipate simply because the state frees the inmate, apologizes, or even provides financial compensation—which often is not the case.

The lesson is as charged as superbolt lightning: An innocent man or woman sentenced to die is the perfect witness against what many see as the inherent immorality and barbarity of continuing capital punishment.

It's a particularly poignant lesson in a nation that executes people at a rate outpaced by few others—and where factors such as a defendant's or victim's race, low income, or inability to counter overly zealous police and prosecutors can put the accused at increased risk of a wrongful conviction that could lead to execution. Race is a particularly strong determinant: As of April 2020, Black people made up more than 41 percent of those on death row but only 13.4 percent of the U.S. population.



Kwame Ajamu

CUYAHOGA COUNTY, OH

27 YEARS IN PRISON,
2 OF THOSE ON DEATH ROW;
EXONERATED IN 2014

Now 63, Kwame Ajamu, who changed his name from Ronnie Bridgeman while in prison, was convicted in 1975 of murdering a Cleveland salesman based solely on the testimony of a 13-year-old boy. Though just a teen

himself, Bridgeman was condemned to die. His sentence was reduced to life in prison in 1978, and he was paroled in 2003, but he lived under the cloud of his conviction. In 2014 the witness testified in court that his original

statement had been false. That testimony helped exonerate three people: Ajamu, his brother, Wiley Bridgeman, and their friend Ricky Jackson. Bridgeman and Jackson were finally released after 39 years in prison.

During the past three decades, groups such as the Innocence Project have shed light on how dangerously fallible the U.S. justice system can be, particularly in capital cases. DNA testing and scrutiny of actions by police, prosecutors, and public defenders have helped exonerate 182 people from death row since 1972, and as of December 2020 had led to more than 2,700 exonerations overall since 1989.

Each of the former death-row inmates I interviewed belongs to an organization called Witness to Innocence. Based in Philadelphia since 2005, WTI is a nonprofit led by exonerated death-row inmates. Its primary goal is to see the death penalty abolished in the U.S. by shifting public opinion on the morality of capital punishment.

During the past 15 years, WTI's outreach targeting the U.S. Congress, state legislatures, policy advisers, and academics has been credited with helping to abolish the death penalty in several states, though it remains legal in 28 states, the federal government, and the U.S. military. In 2020, 17 people were executed in the U.S., 10 by the federal government. It was the first time more prisoners were executed by the federal government than by all of the states combined.

"I was abducted by the state of Ohio when I was 17 years old," Ajamu began our conversation when we met on my backyard patio.

"I was a child when I was sent to prison to be killed," Ajamu, now chairman of WTI's board, told me. "I did not understand what was happening to me or how it could happen. At first I begged God for mercy, but soon it dawned on me that there would be no mercy coming."

The day Ajamu arrived at the Southern Ohio Correctional Facility, a maximum-security prison in rural Ohio, he was escorted to a cell-block filled with condemned men. At the end of death row was a room that held Ohio's electric chair. Before the guards put him in his cell, they made a point of walking him past that room.

"One of the guards really wanted me to see that chair," Ajamu recalled. "I'll never forget his words: 'That's gonna be your hot date.'"

From the time Ajamu was sentenced to die until 2005—when the U.S. Supreme Court ruled that executing juveniles violated the Constitution's ban on cruel and unusual punishment—the nation executed 22 people who were convicted of a crime committed when they were under age 18, according to the Death Penalty Information Center (DPIC).

The high court's ruling countered a history of executing juveniles that began long before the United States was conceived. The first known case of a juvenile executed in the British colonies was in 1642 in the Plymouth Colony, where Thomas Granger, 17, was hanged. His alleged offense was sodomy with livestock.

In the earliest days of the nation, even younger children were subject to the harshest of all judicial penalties. Hannah Ocuish, 12, a Native American girl, was hanged in New London, Connecticut, in 1786 for murder. Two enslaved boys—a 12-year-old convicted of murder and a 13-year-old convicted of arson—were hanged in Virginia in 1787 and 1796, respectively.

For most of the next 200 years, age was ignored as a factor in sentencing. Juveniles and adults alike were tried, convicted, and executed based on their crimes, not their maturity. Available criminal records don't cite the age of the executed regularly until around 1900. By 1987, when the U.S. Supreme Court first agreed to consider the constitutionality of the death penalty for minors, some 287 juvenile executions had been documented. When the Supreme Court ruled in 1978 that Ohio's death penalty law violated the Eighth Amendment's ban on cruel and unusual punishment, as well as the 14th Amendment's requirement of equal protection under the law, Ajamu's death sentence was reduced to life in prison. Still, he lingered behind bars for another quarter of a century, when he was released on parole. He wouldn't be exonerated until 2014, after a crusading reporter for a Cleveland magazine and the Ohio Innocence Project helped unravel the lie that had sent Ajamu to death row.

"There is a wide array of blunders that can cause erroneous convictions in capital cases," said Michael Radelet, a death penalty scholar and sociologist at the University of Colorado Boulder. "Police officers might secure a coerced or otherwise false confession. Prosecutors occasionally suppress exculpatory evidence. Sometimes there is a well-intentioned but mistaken eyewitness identification. Most common is perjury by prosecution witnesses."

Few opponents of capital punishment summarize the case against state-sponsored executions more bluntly than Sister Helen Prejean, co-founder of WTI and author of *Dead Man Walking*, the best-selling book that inspired the 1995 film of the same title, starring Susan Sarandon and Sean Penn.

The plainspoken nun described how her animus toward the death penalty became personal by recalling her fear of a fairly routine dental experience she underwent years ago.

"I had to have a root canal on a Monday morning," she told me. "The whole week before that root canal, I dreamt about it. As the appointment got closer, the more nervous I became."

She continued, "Now imagine anticipating your scheduled appointment to be put to death. The six people that I've accompanied onto death row all had the same nightmare. The guards were dragging them from their cells. They cry for help and struggle. Then they wake up and realize that they are still in their cells. They realize it's just a dream. But they know that one day the guards are really going to come for them, and it won't be a dream. That's the torture. It's a torture that as of yet our Supreme Court refuses to recognize as a violation of the Constitution's prohibition against cruel and unusual punishments."

More than 70 percent of the world's nations have rejected the death penalty in either law or practice, according to the DPIC. Of the places where Amnesty International has recorded recent executions, the U.S.—which has the highest incarceration rates in the world—was one of just 13 countries that held executions every one of the past five years. Americans' support for capital punishment has dropped significantly since 1996, when 78 percent supported the death penalty for people convicted of murder. By 2018, support had fallen to 54 percent, according to the Pew Research Center.

"If I were to be murdered," wrote Prejean, "I would not want my murderer executed. I would not want my death avenged—*especially by government*—which can't be trusted to control its own bureaucrats or collect taxes equitably or fill a pothole, much less decide which of its citizens to kill."

BEFORE RAY KRONE WAS SENTENCED TO DIE, his life bore no resemblance to Ajamu's. From tiny Dover, Pennsylvania, Krone was the eldest of three children and a typical small-town American boy. Raised a Lutheran, he sang in a church choir, joined the Boy Scouts, and as a teenager was known as a fairly smart kid, a bit of a prankster. He pre-enlisted in the Air Force during high school; after graduating, he served for six years.

Having received an honorable discharge, he stayed in Arizona and went to work for the

BLACK PEOPLE MAKE UP MORE THAN 41 PERCENT OF DEATH-ROW INMATES BUT ONLY 13.4 PERCENT OF THE U.S. POPULATION.

U.S. Postal Service, a job he planned to keep until retirement.

That career dream—and his life—were abruptly shattered in December 1991, when Kim Ancona, a 36-year-old bar manager, was found stabbed to death in the men's bathroom of a Phoenix lounge that Krone frequented.

Police immediately zeroed in on Krone as a suspect after learning that he'd given Ancona, whom he knew casually, a ride to a Christmas party a few days earlier. The day after her body was discovered, Krone was ordered to provide blood, saliva, and hair samples. A dental cast of his teeth also was created. The next day he was arrested and charged with aggravated murder.

Investigators said the distinctive misalignment of Krone's teeth matched bite marks on the victim's body. Media reports would soon derisively refer to Krone as the "snaggletooth" killer. As was the case with Ajamu, there was no forensic evidence linking Krone to the crime. DNA was a fairly new science, and none of the saliva or blood collected at the crime scene was tested for DNA. Simpler blood, saliva, and hair tests were inconclusive. Exculpatory evidence was available but ignored, such as shoe prints found around the victim's body that didn't match the size of Krone's feet or any shoes he owned.

Based on little more than the testimony of a dental analyst who said the bite marks on the victim's body matched Krone's misaligned front teeth, a jury found Krone guilty. He was sentenced to death.

"It's a devastating feeling when you recognize that everything you've ever believed in and stood for has been taken away from you, and without just cause," Krone told me. "I was so naive. I didn't believe this could actually happen

2,133

YEARS LOST FOR THE WRONGLY CONVICTED

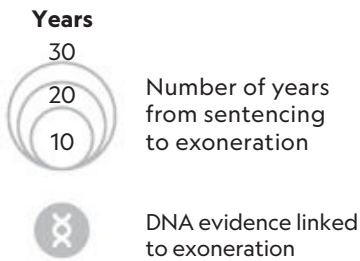
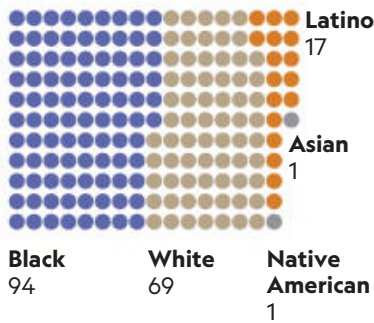
During the past five decades 182 former death-row prisoners, an average of four people a year, have been exonerated of all charges related to their death sentences. Advances such as the use of DNA testing have led to a small decrease in wrongful convictions but have not been sufficient to overcome official misconduct and human error.

DATE OF CONVICTION

The **modern era of the death penalty** is considered to have started after a 1972 Supreme Court ruling condemned state laws and demanded reform.

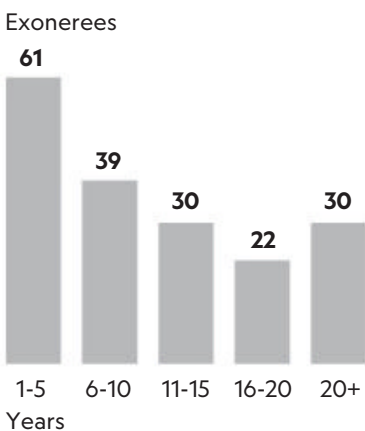
182

PEOPLE HAVE BEEN EXONERATED



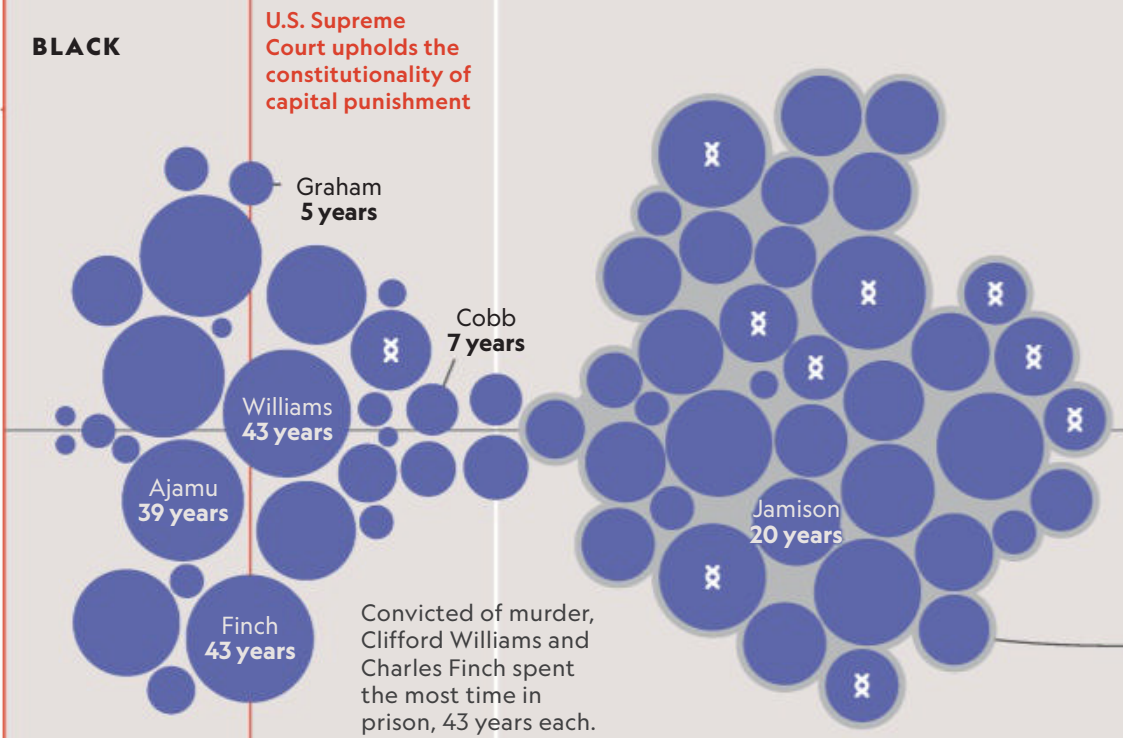
YEARS UNTIL EXONERATION

The exonerees lost years—almost 12 on average—for crimes they didn't commit. Here they're grouped by time wrongfully convicted.

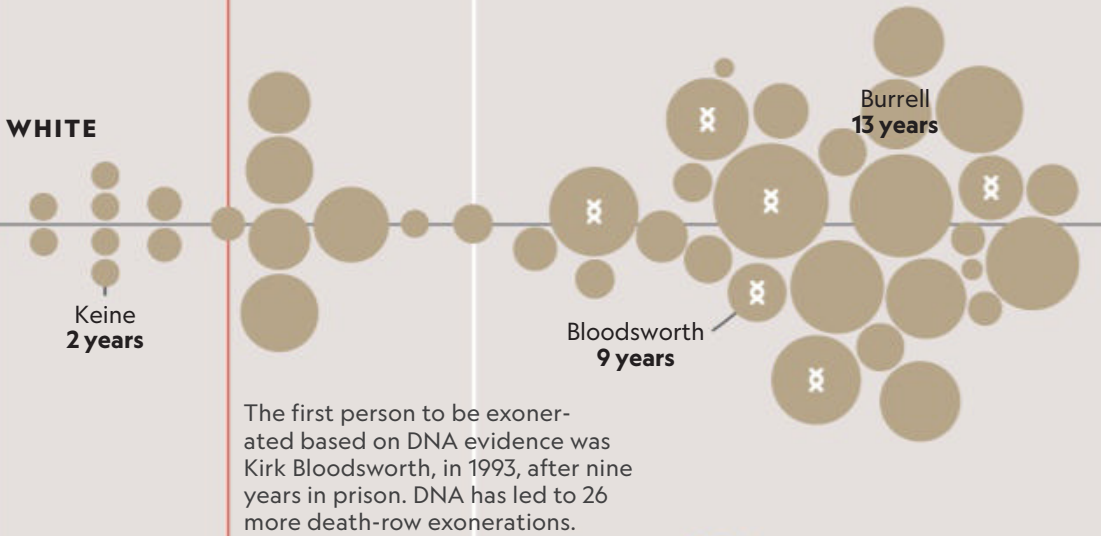


1972 1975 1976 1980 1985

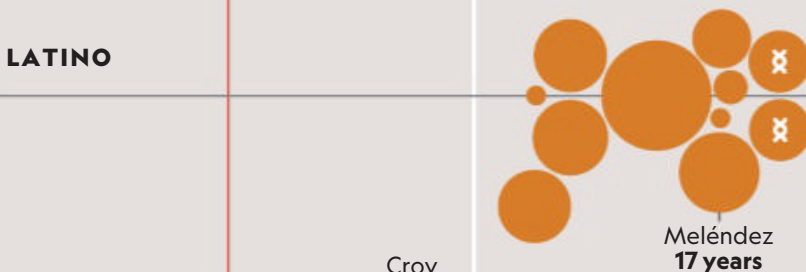
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WHITE



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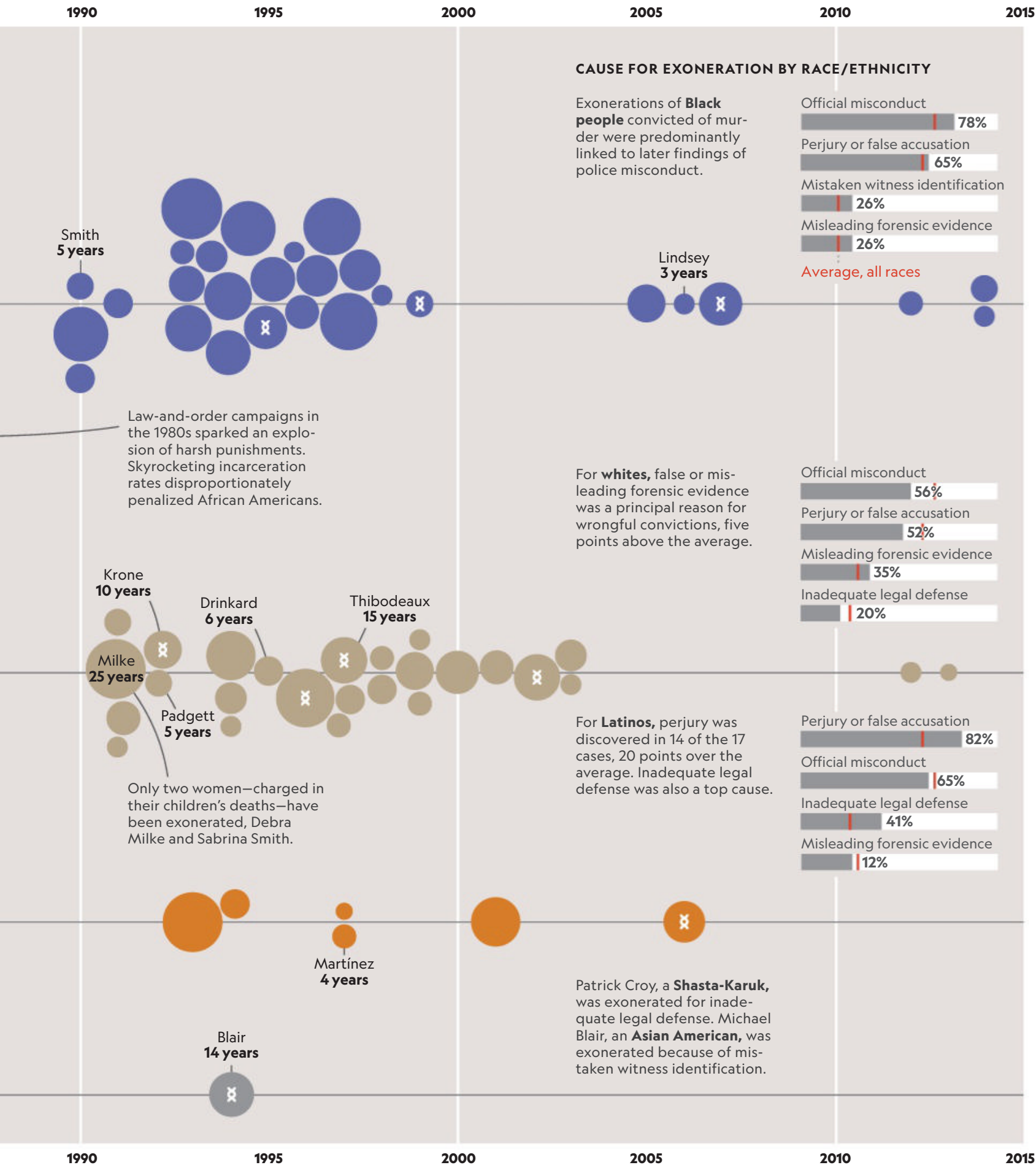
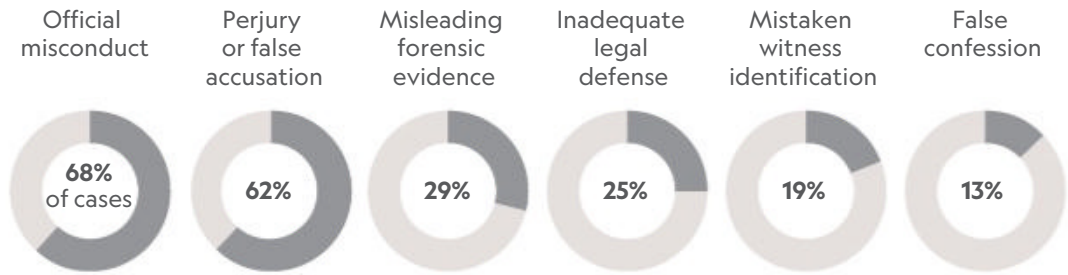
NATIVE AMERICAN AND ASIAN



1972 1975 1976 1980 1985

REASON FOR EXONERATION

Two out of three cases involved official misconduct, such as concealing evidence. In many cases a witness lied under oath, committing perjury.



DATA AS OF DECEMBER 15, 2020. ONLY INDIVIDUALS SENTENCED TO DEATH AFTER 1972 ARE INCLUDED. MONICA SERRANO, NGM STAFF; KELSEY NOWAKOWSKI. SOURCE: DEATH PENALTY INFORMATION CENTER

MORE THAN 70 PERCENT OF ALL COUNTRIES HAVE REJECTED CAPITAL PUNISHMENT.

to me. I had served my country in uniform. I worked for the post office. I wasn't perfect, but I had never been in trouble. I'd never even gotten a parking ticket, but here I was on death row. That's when I realized that if it could happen to me, it could happen to anyone."

The Maricopa County Attorney's Office spent upwards of \$50,000 on the prosecution, centered on its bite-mark theory, while the consulting dental expert for Krone's publicly funded defense was paid \$1,500. This discrepancy in resources available to prosecutors and defendants in capital cases has long been replicated across the nation, leading to predictable outcomes for defendants staked to under-resourced and often ineffective legal counsel.

Krone got a new trial in 1995, when an appeals court ruled that prosecutors had wrongly withheld a videotape of the bite evidence until the day before the trial. Again, he was found guilty. Prosecutors relied on the same dental analysts who'd helped convict Krone the first time. But this time the sentencing judge ruled that a life sentence was appropriate, not death.

Krone's mother and stepfather refused to give up on their belief in their son's innocence. They mortgaged their house, and the family hired their own lawyer to look into the physical

evidence collected during the original investigation. Over objections by the prosecution, a judge granted a request by the family's lawyer to have an independent lab examine DNA samples, including saliva and blood from the crime scene.

In April 2002 the DNA test results showed that Krone was innocent. A man named Kenneth Phillips, who lived less than a mile from the bar where Ancona was killed, had left his DNA on clothes Ancona had been wearing. Phillips was easy to find: He already was in prison for sexually assaulting and choking a seven-year-old girl.

When Krone was released from prison four days after the DNA test results were announced, he became known as the hundredth man in the United States since 1973 who'd been sentenced to death but later proved innocent and freed.

GARY DRINKARD was no choirboy. He'd had prior brushes with the law when Dalton Pace, a junk dealer, was robbed and killed in Decatur, Alabama, in August 1993.

Police arrested Drinkard, then 37, two weeks later when Beverly Robinson, Drinkard's half sister, and Rex Segars, her partner, struck a deal with police that implicated Drinkard in the slaying. Facing unrelated robbery charges that also potentially implicated Drinkard, the couple agreed, in exchange for the charges being dropped against them, to cooperate with police and testify that Drinkard told them he'd killed Pace.

When I spoke with Drinkard, he reminded me of a weather-beaten man straight out of a Merle Haggard song. He wore coveralls and chain-smoked Newports. He spoke slowly and guardedly in a deep southern drawl. He grew exasperated only when I asked him to describe his time on death row.

"I thought they were going to kill me," Drinkard said. That certainly seemed to be the plan. Using testimony from their star witnesses (the half sister and her partner), prosecutors hammered home the alleged confession while

Randal Padgett

MARSHALL COUNTY, AL

5 YEARS IN PRISON,
ALL ON DEATH ROW;
EXONERATED IN 1997

After Randal Padgett's wife, Cathy, was fatally stabbed in August 1990, police in Alabama charged him with capital murder. The couple had separated, and Padgett, a chicken farmer, was dating another woman. At his

trial in 1992, prosecutors failed to promptly tell the defense that blood from the crime scene didn't match Randal Padgett's. Upon learning this, defense lawyers asked for a mistrial, which the judge denied. After Padgett

was found guilty, the same judge sentenced him to death. Three years later, Alabama's Court of Criminal Appeals ordered a new trial, citing the prosecutors' actions. Padgett, now 70, was found not guilty and released.





Sabrina Smith

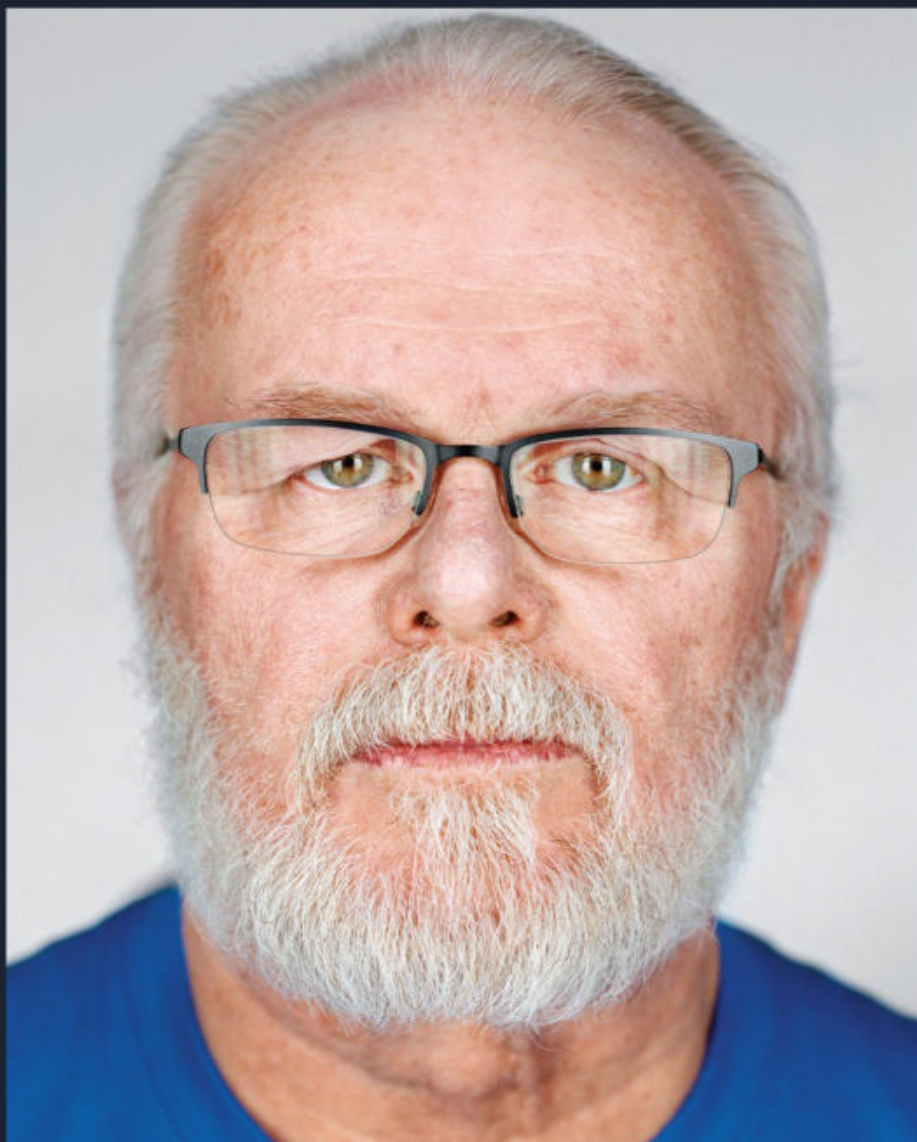
LOWNDES COUNTY, MS

5 YEARS IN PRISON,
HALF OF THEM ON DEATH ROW;
EXONERATED IN 1995

During her 1990 trial, Smith, née Sabrina Butler, now 50, was convicted of murdering her infant son, Walter. She was just 18. Her court-appointed attorneys called no witnesses who could have testified that

the boy's injuries were consistent with her efforts to revive him after he'd stopped breathing. Butler wasn't put on the stand to support her claim of innocence. Citing improper actions by prosecutors,

Mississippi's supreme court ordered a new trial, which resulted in her exoneration. She's one of only two U.S. women on death row to be exonerated; the other is Debra Milke of Arizona, who spent 25 years in prison.



Kirk Bloodsworth

BALTIMORE COUNTY, MD

**9 YEARS IN PRISON,
2 OF THEM ON DEATH ROW;
EXONERATED IN 1993**

In 1993 Bloodsworth, now 60, became the first person in the U.S. to be exonerated from death row by DNA. He was convicted of the 1984 rape and murder of a nine-year-old girl based on the testimony of five witnesses who put him near the site. No physical evidence linked him to the crime, but he was sentenced to die. Nine years later, DNA testing of stored evidence proved his innocence; it would be another decade before the real killer was identified and charged.



Juan Meléndez

POLK COUNTY, FL

**17 YEARS IN PRISON,
ALL ON DEATH ROW;
EXONERATED IN 2002**

Meléndez learned to speak English while on Florida's death row. When he tells his exoneration story, he recounts the number of years, months, and days he spent there. No physical evidence linked him to the 1983 homicide he was convicted of, but he wasn't exonerated until a transcript surfaced of a taped confession by the actual killer. The transcript had long been available, but the prosecutor hadn't shared it with Meléndez's defense. Once it was discovered, a judge overturned the conviction. Meléndez learned after his release that his mother had saved money to ship her son's body home to Puerto Rico, his birthplace, after his execution.





Shujaa Graham

SAN JOAQUIN
COUNTY, CA

**11 YEARS IN PRISON,
5 OF THEM ON DEATH ROW;
EXONERATED IN 1981**

Graham, right, 69, with his son, Jabari, showing off a tattoo of his father, was a troubled teen who spent part of his adolescence in juvenile detention facilities. He was already in adult prison when convicted of killing a prison guard in Stockton, California, in 1973. The state supreme court overturned his conviction in 1979 after it was revealed that prosecutors had systematically excluded Black jurors. In a 1981 retrial, he was exonerated. Today he is an avid speaker on death penalty and racial justice issues.

improperly influencing the jury with references to Drinkard's alleged involvement in those earlier thefts. Drinkard's public defenders, who had no experience in capital cases and very little in criminal law, mostly stood mute. They made no real attempt to introduce evidence that could have proved their client's innocence. Drinkard was found guilty in 1995 and sentenced to death. He would spend close to six years on death row.

In 2000 the Supreme Court of Alabama ordered a new trial because of the prosecution's introduction of Drinkard's criminal history.

"Evidence of a defendant's prior bad acts... is generally inadmissible. Such evidence is presumptively prejudicial because it could cause the jury to infer that, because the defendant has committed crimes in the past, it is more likely that he committed the particular crime with which he is charged," the court wrote in granting a new trial.

Drinkard's case had drawn the attention of the Southern Center for Human Rights, an organization that fights capital punishment. It provided him with legal counsel. At Drinkard's 2001 retrial, his lawyers introduced evidence that indicated Drinkard was suffering from a debilitating back injury and was heavily medicated at the time of the slaying. Drinkard's lawyers argued that he had been at home and on workers' compensation when Pace was killed, so he couldn't have committed the crime. A county jury found Drinkard not guilty within one hour, and he was released.

"I was not opposed to capital punishment until the state tried to kill me," Drinkard said.

THERE HAVE BEEN more than 2,700 exonerations overall in the U.S. since 1989, the first year that DNA became a factor, according to the National Registry of Exonerations.

In 1993 Kirk Bloodsworth was the first person in the nation to be exonerated from death row based on DNA evidence. Bloodsworth was arrested in 1984 and charged with raping and

murdering Dawn Hamilton, a nine-year-old girl, near Baltimore, Maryland. Police were alerted to Bloodsworth, who had just moved to the area, when an anonymous tipster reported him after seeing a televised police sketch of the suspect.

Bloodsworth bore little resemblance to the suspect in the police sketch. No physical evidence linked him to the crime. He had no prior criminal record. Yet Bloodsworth was convicted and sentenced to death based primarily on the testimony of five witnesses, including an eight-year-old and a 10-year-old, who said they could place him near the murder scene. Witness misidentification is a factor in many wrongful convictions, according to the DPIC.

"Give him the gas and kill his ass," Bloodsworth recalled people in the courtroom chanting after he was sentenced. All the while, he wondered how he could be sentenced to die for a ghastly crime he hadn't committed.

He was granted a second trial nearly two years later, after it was shown on appeal that prosecutors had withheld potentially exculpatory evidence from his defense, namely that police had identified another suspect but failed to pursue that lead. Again, Bloodsworth was found guilty. A different sentencing judge handed Bloodsworth two life sentences, rather than death.

"I had days when I was giving up hope. I thought I was going to spend the rest of my life in prison. And then I saw a copy of Joseph Wambaugh's book," Bloodsworth said.

That 1989 book, *The Bleeding*, describes the then emerging science of DNA testing and how law enforcement had first used it to both clear suspects and solve a rape and murder case.

Bloodsworth wondered whether that science could somehow clear his name.

When he asked whether DNA evidence could be tested to prove that he was not at the crime scene, he was told the evidence had been destroyed inadvertently. That wasn't true. The evidence, including the girl's underwear, later

Gary Drinkard

MORGAN COUNTY, AL

6 YEARS IN PRISON,
ALL ON DEATH ROW;
EXONERATED IN 2001

Police arrested Gary Drinkard, now 62, two weeks after a junk dealer was robbed and killed in Decatur, Alabama, in August 1993. In exchange for burglary charges being dropped against them, Drinkard's half sister and her

partner testified that Drinkard had killed the junk dealer. Drinkard's public defenders presented no evidence to prove his innocence. He was found guilty and sentenced to death in 1995. In 2000 the Alabama supreme court

ordered a new trial because prosecutors had wrongly introduced Drinkard's criminal history. At that trial, evidence showed he was home with a back injury the night of the murder. He was found not guilty and freed.



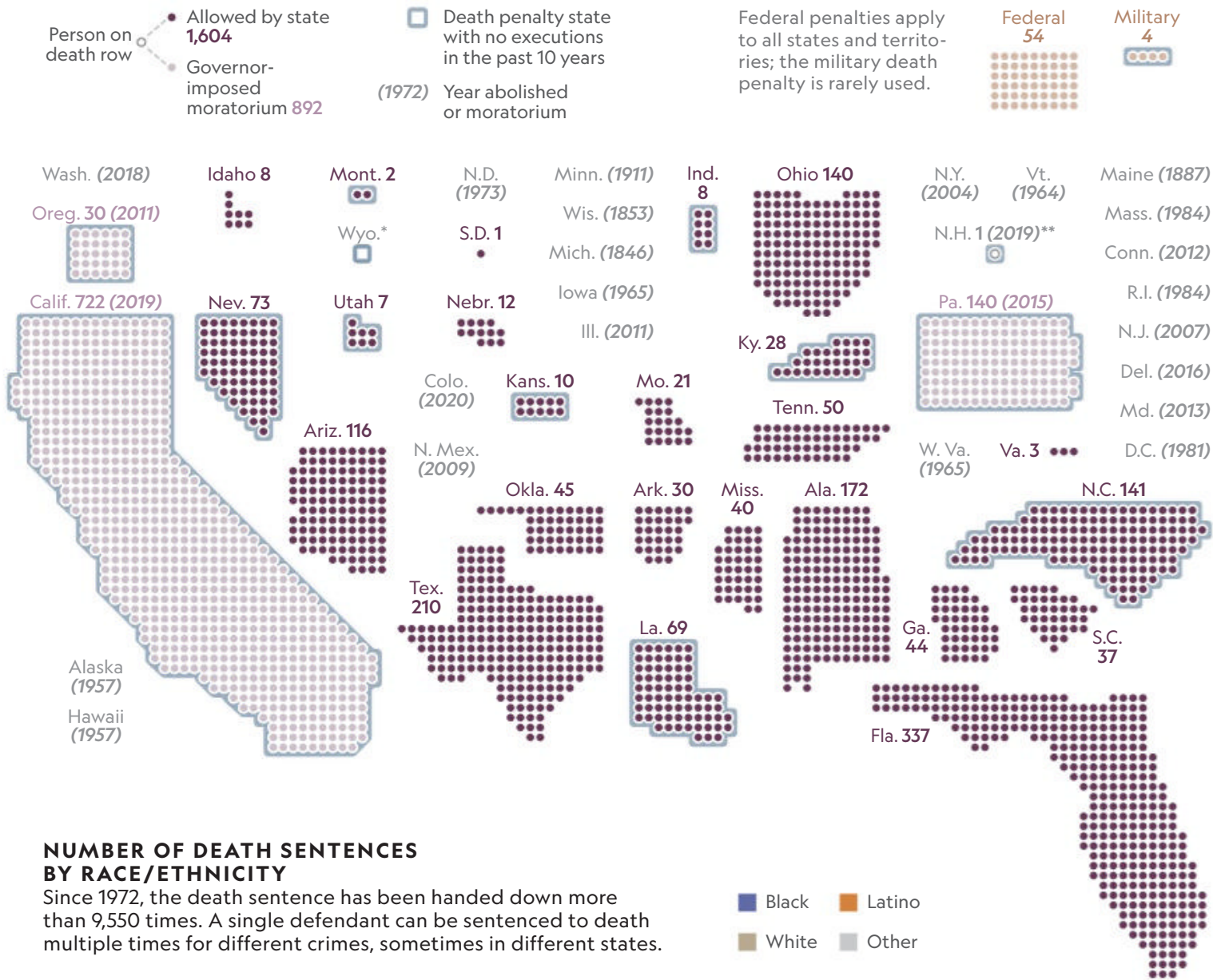
2,555

PEOPLE ARE ON DEATH ROW IN THE UNITED STATES

In 1972 the U.S. Supreme Court ruled that the death penalty violated the Eighth Amendment's ban on cruel and unusual punishment. Twenty-two states have abolished it; others have enacted new laws to conform to the court's rulings. Today there are prisoners on death row in 28 states and in federal and U.S. military facilities.

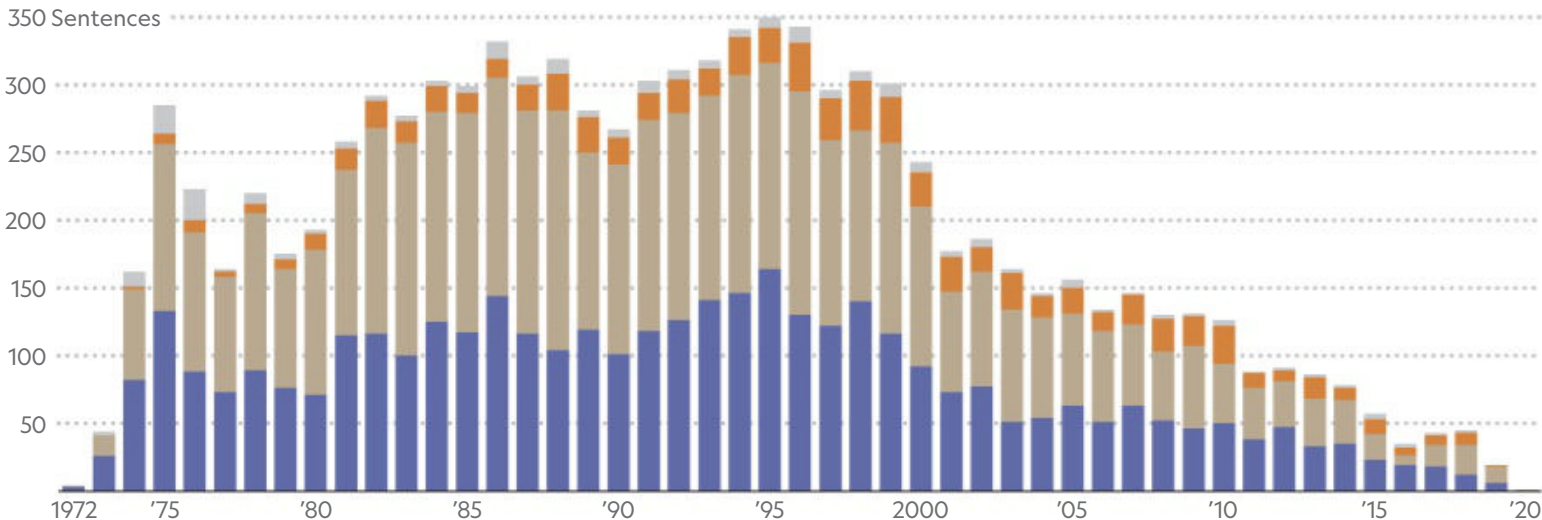
STATE DEATH PENALTY STATUS

Each dot represents one person now on death row.



NUMBER OF DEATH SENTENCES BY RACE/ETHNICITY

Since 1972, the death sentence has been handed down more than 9,550 times. A single defendant can be sentenced to death multiple times for different crimes, sometimes in different states.



*WYOMING HAS NOT ISSUED A DEATH SENTENCE SINCE 1982. THE GOVERNOR CONSIDERED A MORATORIUM IN 2020.

**NEW HAMPSHIRE ABOLISHED THE DEATH PENALTY IN 2019. THE REPEAL BILL DID NOT APPLY TO THE ONE PRISONER ON THE STATE'S DEATH ROW.

*THOUSANDS OF EXECUTIONS ARE BELIEVED TO HAVE BEEN CARRIED OUT IN CHINA BUT NOT PUBLICLY ACKNOWLEDGED.

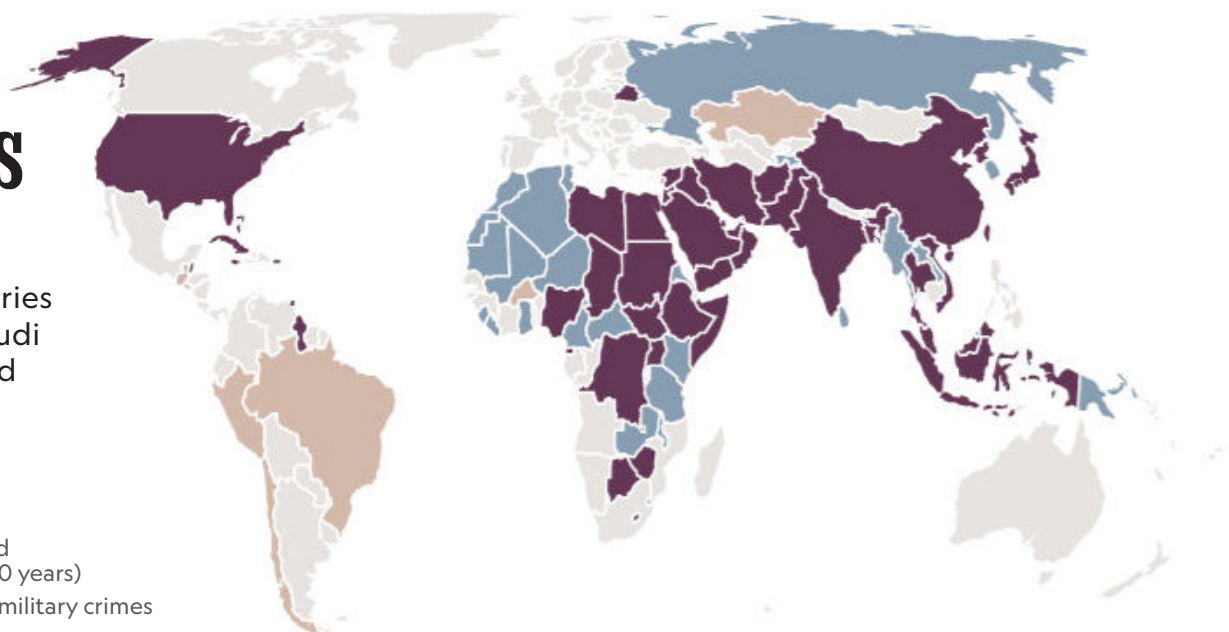
DATA AS OF DECEMBER 15, 2020. ONLY INDIVIDUALS SENTENCED TO DEATH AFTER 1972 ARE INCLUDED.

CHRISTINE FELLEZ, NGM STAFF; KELSEY NOWAKOWSKI. SOURCES: AMNESTY INTERNATIONAL; DEATH PENALTY INFORMATION CENTER

GLOBAL EXECUTIONS

Amnesty International recorded at least 657 executions in 20 countries in 2019. China,[†] Iran, Saudi Arabia, Iraq, Egypt, and the U.S. head the list, in that order.

- Death penalty
- Death penalty not practiced (no executions in the past 10 years)
- Allowed for exceptional or military crimes
- No death penalty



was found in the courthouse. Prosecutors, sure of their case, agreed to release the items.

Once the items were tested, usable DNA was detected—none of it Bloodsworth’s. He was freed, and six months later, in December 1993, Maryland’s governor granted him a full pardon. It would be almost another decade before the actual killer was charged. The DNA belonged to a man named Kimberly Shay Ruffner, who had been released from jail two weeks before the girl’s murder. For a time Ruffner, who was given a 45-year sentence for an attempted rape and attempted murder soon after Bloodsworth’s arrest, and Bloodsworth were housed in the same prison. Ruffner pleaded guilty to Hamilton’s murder and was sentenced to life in prison.

Today Bloodsworth is the executive director of WTI and a tireless campaigner against capital punishment. The Innocence Protection Act, signed into law by President George W. Bush in 2004, established the Kirk Bloodsworth Post-Conviction DNA Testing Grant Program to help defray the cost of DNA testing after conviction.

“I was poor and had only been in the Baltimore area for 30 days when I was arrested,” said Bloodsworth, now 60. “When I tell people my story and how easy it is to be convicted of something of which you’re innocent, it often causes them to rethink the way the criminal justice system works. It doesn’t require much of a stretch to believe that innocent people have been executed.”

SABRINA BUTLER discovered that Walter, her nine-month-old son, had stopped breathing shortly before midnight on April 11, 1989. An 18-year-old single mother, Butler responded with urgent CPR. When the child could not be revived after several minutes, she raced him

to a hospital in Columbus, Mississippi, where he was pronounced dead on arrival. Less than 24 hours later she was charged with murder.

Walter had serious internal injuries when he died. Butler told police investigators she believed that the injuries were caused by her efforts to revive him. Police doubted her story, and after several hours of interrogation, without a lawyer present, she signed a statement that said she’d struck her baby in the stomach after he wouldn’t stop crying. Eleven months later Butler was convicted of murder and sentenced to die.

Butler’s defense team called no witnesses. A medical expert might have testified that Walter’s injuries were consistent with the clumsy CPR of a desperate mother. A neighbor—who was called as a witness during a subsequent trial—could have provided helpful testimony of Butler’s attempts to save her son’s life. Instead Butler’s court-appointed lawyers, including one who specialized in divorce law, neither called witnesses nor put Butler on the witness stand to support her case.

“Here I was, this young Black child in a room full of white adults,” Butler, now Sabrina Smith, recalled. “I did not understand the proceedings. All that I had been told by my attorneys was to sit quietly and look at the jury. When I realized my defense wasn’t going to call any witnesses to help prove my innocence, I knew my life was over.”

Butler’s conviction and sentence were set aside in August 1992, after Mississippi’s supreme court ruled that the prosecutor had improperly commented on her failure to testify at trial. A new trial was ordered.

The second trial, with better lawyers, working pro bono, resulted in exoneration. A neighbor testified about Butler’s frantic attempts to revive



Joaquín José Martínez

HILLSBOROUGH CY, FL

4 YEARS IN PRISON,
ALL ON DEATH ROW;
EXONERATED IN 2001

Joaquín José Martínez, 49, is the only European to be exonerated from death row in the U.S. He was convicted of the 1995 murder of two people in Florida and sentenced to die. Florida's supreme court overturned

his convictions and ordered a new trial, citing prosecutors' efforts to prejudice jurors and improper statements by police during Martínez's trial. At the retrial, several prosecution witnesses recanted

their testimony. In 2001 Martínez was acquitted. He now lives in Spain and campaigns against the death penalty. When Martínez was on death row, Pope John Paul II called for his life to be spared.



Perry Cobb

COOK COUNTY, IL

**7 YEARS IN PRISON,
ALL ON DEATH ROW;
EXONERATED IN 1987**

Cobb, 79, once held the dubious U.S. record for most trials for the same slayings. He was tried five times for two killings at a Chicago hot dog stand in 1977. The first two trials ended in hung juries; in a third, he was found guilty and sentenced to death. The Illinois Supreme Court reversed the conviction, saying Cobb and a co-defendant were deprived of a fair trial. A fourth trial ended in a hung jury, and in Cobb's fifth trial a judge acquitted him. Cobb was pardoned by the Illinois governor in 2000.



Damon Thibodeaux

JEFFERSON PARISH, LA

**15 YEARS IN PRISON,
ALL ON DEATH ROW;
EXONERATED IN 2012**

Thibodeaux, now 46, was convicted of raping and murdering a 14-year-old cousin after he confessed under extended police interrogation and sleep deprivation. He recanted but was convicted despite contradictions between his confession and the facts of the crime. He had been on death row for 10 years when the Jefferson Parish district attorney, working with his lawyers and the Innocence Project, reopened the case and did DNA and other forensic tests. They found that the girl hadn't been sexually assaulted and that DNA from the scene wasn't his. His confession was determined to be false.

Ray Krone

MARICOPA
COUNTY, AZ

**10 YEARS IN PRISON,
4 OF THEM ON DEATH ROW;
EXONERATED IN 2002**

In April 2002 Krone, now 64, became known as the 100th man to be exonerated from death row. He'd been convicted of murdering a 36-year-old bar manager who was killed in a bathroom of a Phoenix lounge that Krone frequented. Krone had given her a ride to a party a few days earlier. DNA at the crime scene went untested; the prosecution relied on faulty bite-mark evidence.

When the DNA was submitted as evidence in a retrial, Krone was cleared. The actual killer identified by the DNA was already in prison for sexually assaulting and choking a seven-year-old girl.





Herman Lindsey

BROWARD COUNTY, FL

3 YEARS IN PRISON,
2 OF THEM ON DEATH ROW;
EXONERATED IN 2009

Lindsey, now 48, was convicted in 2006 of robbing and murdering a Fort Lauderdale pawnshop clerk in 1994. No physical or forensic evidence linked him to the case. Even so, police pinned the long-unsolved killing

on Lindsey. He spent two years on death row before Florida's supreme court threw out his convictions and exonerated him. The court cited a lack of evidence and blasted prosecutors for improper conduct

that it said biased the jury. Lindsey still lives in Florida, which has the highest number of death-row exonerations in the U.S. He fishes (here with his stepson) and counsels youths about avoiding bad decisions.

her child. A medical expert testified that the child's injuries could have resulted from the CPR efforts. Evidence also was introduced indicating that Walter had a preexisting kidney condition that likely contributed to his sudden death. Butler was released after spending five years in prison, the first half of that on death row.

Less than two years after her exoneration, Butler, the first of just two American women ever to be exonerated from death row, received a summons for jury duty.

"I was so appalled," she told me. "I went downtown and spoke to the court administrator. I explained to him that the state of Mississippi had tried to kill me. I told him I was quite certain that I would not make a good juror." She was dismissed.

A QUESTION that frequently confounds exonerees and the general public alike is whether a consistent formula exists for compensating the falsely convicted, especially those sentenced to die. The short answer is no. A small number of exonerees have been compensated for millions of dollars depending on the laws of the state that convicted them, but many receive little or nothing.

Few death-row exonerees more closely follow the issue of compensation than Ron Keine, who lives in southeastern Michigan. Keine has made it part of his life's mission to improve the plight of the wrongly convicted, who often reenter society with meager survival skills. He wasn't always so benevolent.

Growing up in Detroit, Keine ran with a rough crowd. He'd been shot and stabbed before he turned 16. At age 21, he and his closest friend, who both belonged to a notorious motorcycle club, decided to drive a van across the U.S.

The extended open-road party was going as planned until he and four others were arrested in 1974 in Oklahoma and extradited to New Mexico, where they were charged with the murder and mutilation of a 26-year-old college student in Albuquerque. A motel housekeeper reported

that the group raped her and that she then saw the group kill the student at the same motel.

The problem with the story should have been readily apparent. The bikers weren't in Albuquerque when William Velten, Jr., the student, was killed. They were partying in Los Angeles and had a dated traffic citation to prove it. The housekeeper later recanted her story.

In September 1975 a drifter, Kerry Rodney Lee, confessed to killing Velten, possibly because he felt guilty knowing that four men were on death row for his crime. The gun used in Velten's slaying matched a gun stolen from the father of Lee's girlfriend. Based on this evidence, Keine and his biker friends were granted new trials and the prosecutor decided not to indict them. Lee was convicted in May 1978 of murdering Velten.

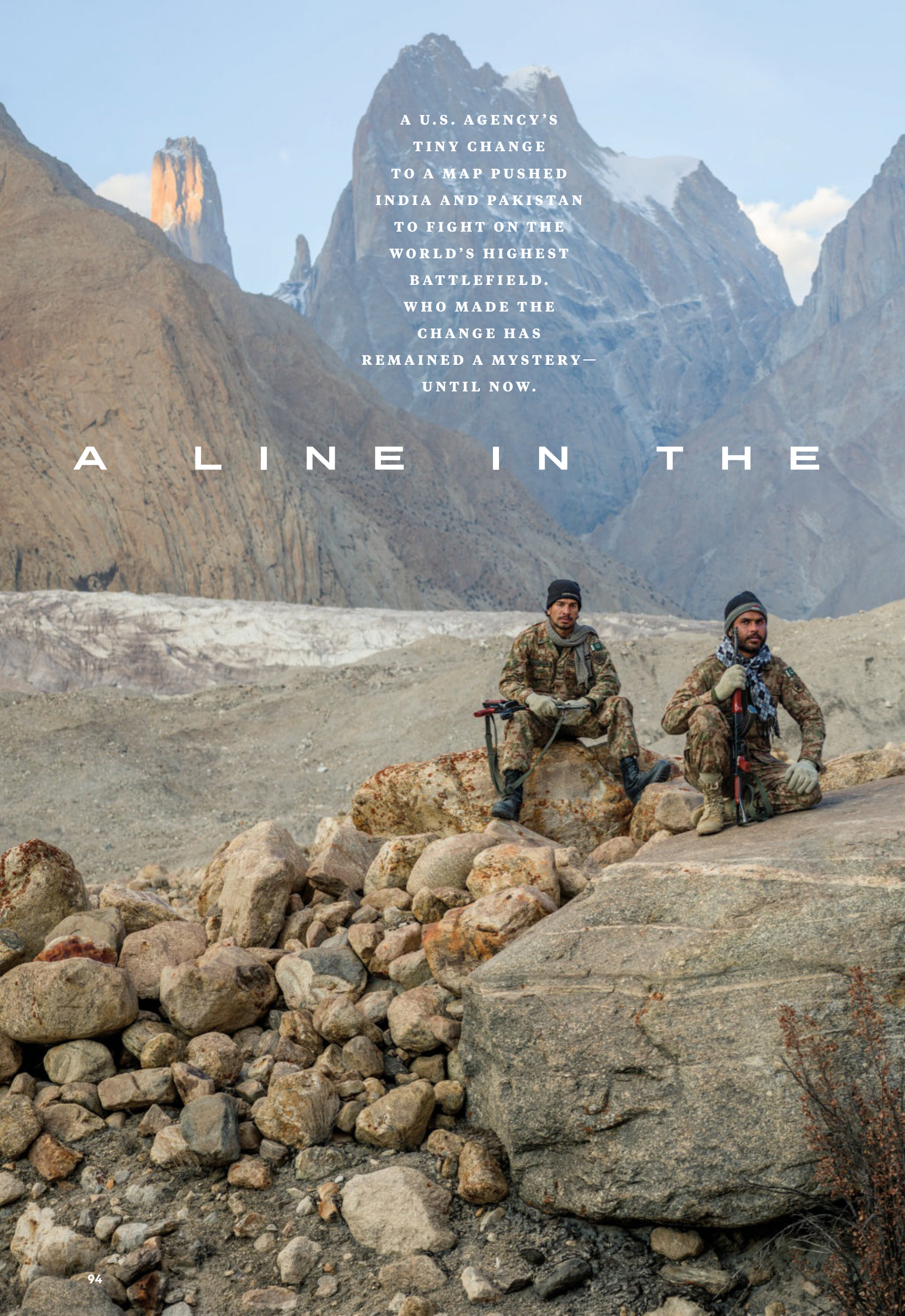
"When I was on death row, I knew I was innocent, but I still came within nine days of my first scheduled execution date," said Keine, now 73. "I didn't have a voice. So when I got out, I decided I was going to spend my life being a thorn" in the side of the criminal justice system. "I decided that I was going to go from dead man walking to dead man talking."

Keine, who founded several successful small businesses after his exoneration, has testified before state legislators seeking to overturn capital punishment laws. Having received only a \$2,200 settlement from the county that put him on death row, he has been vocal in calling for a system of compensation for others wrongly sentenced to death.

"When people get off death row, they feel like a piece of shit," he said. "They don't have any self-worth—no self-esteem, and they usually don't have two nickels in their pocket. We try to build them up. We try and help them find the resources they need to survive." □

Phillip Morris wrote the story on rethinking monuments in our February issue. **Martin Schoeller** specializes in portraiture and is currently focusing on death-row exonerees and Holocaust survivors.



A full-page photograph of two soldiers in camouflage uniforms sitting on a rocky ridge. They are wearing headgear and scarves, suggesting cold weather. The background features jagged, snow-capped mountain peaks under a clear sky. The foreground is filled with large, light-colored rocks.

A U.S. AGENCY'S
TINY CHANGE
TO A MAP PUSHED
INDIA AND PAKISTAN
TO FIGHT ON THE
WORLD'S HIGHEST
BATTLEFIELD.
WHO MADE THE
CHANGE HAS
REMAINED A MYSTERY—
UNTIL NOW.

A LINE IN THE



M O U N T A I N S

BY FREDDIE WILKINSON
PHOTOGRAPHS BY CORY RICHARDS





Pakistani soldiers unload an Mi-17 helicopter at the Paiju administrative post. Vital supplies range from drums of aviation fuel to construction rebar to fresh eggs. For troops deployed along both sides of the Saltoro Range, helicopters are a lifeline. "Angels from above," one officer said.

PREVIOUS PHOTO

Soldiers assigned to the 62 Brigade of the Pakistan Army pause beneath the Trango Towers at the terminus of the Baltoro Glacier. "It's difficult terrain," one says. "But we must defend every inch of our motherland."

At the Sarfaranga firing range outside Skardu, Pakistani soldiers clean their G3A3 rifles and snack on bananas during a training session.



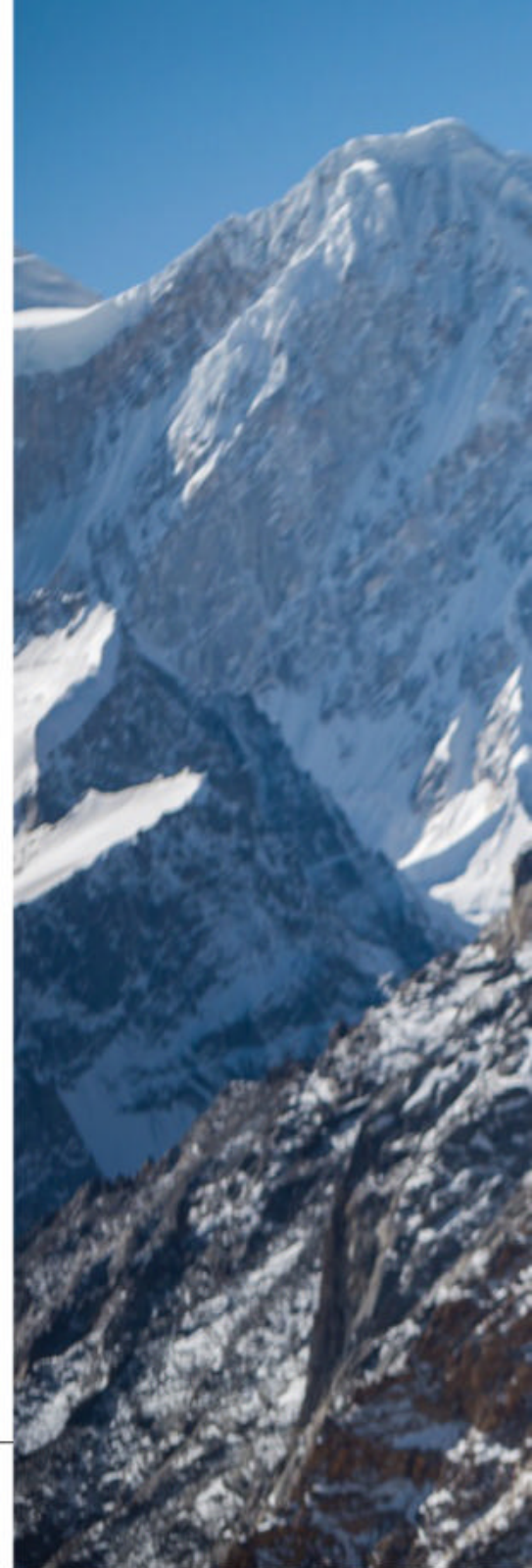


M

Maj. Abdul Bilal of the Pakistan Army's Special Service Group huddled with his team beneath a rock outcropping deep in the Karakoram Range. It was April 30, 1989, and a late afternoon snow squall gathered around the 11 men as they labored to breathe the thin air more than four miles above sea level. At first glance they might have appeared to be mountaineers, except for the white camouflage jackets they wore and the automatic weapons slung over their shoulders.

In fact, mountaineers would have been jealous of this vantage point, which offered a panorama of some of the world's most colossal mountains. The hulk of K2, the second highest point on Earth, loomed just over the horizon, 50 miles to the northwest. But the majority of the icy peaks remained unclimbed and nameless, identified on maps only by numbers that corresponded to their elevations.

Climbing to their position on this peak, labeled 22,158, would've required ascending an avalanche-riddled face of rock and ice. Four men had died trying. Instead, Bilal's team had been ferried by helicopter. One by one, the men dangled from ropes as the helicopters struggled to stay aloft in the thin, subfreezing atmosphere. Deposited some 1,500 feet below the summit, the team spent a week fixing ropes and



Ropes keep teams safe while traversing some types of terrain. Here soldiers of Pakistan's 323 Brigade have tied themselves together to lessen the chance one will be lost in an icy abyss as they cross the Gyong Glacier at 17,500 feet. Many crevasses are known by the names of soldiers who have died in their depths.

Editor's Note:
National Geographic asked the Indian Army to allow our writer and photographer to visit the Indian-controlled Siachen Glacier. The army declined to grant access.



reconnoitering the terrain above to prepare for this decisive moment.

A few men suggested they rope up for safety. “If you rope up, if one of us is hit, then all of us go down,” Bilal told them. “Wear crampons but no ropes.” They made a final check to make sure the moving parts on their weapons hadn’t frozen. And then, just before dusk, with howling wind at their backs, Bilal led the team single file as they climbed up a corniced ridge toward the summit.

Suddenly the dark, sunburned faces of two Indian sentries peered down from a wall of snow built in a makeshift observation post. Bilal called out to them in Urdu, “You are surrounded by soldiers of the Pakistan Army. Lay down your arms.”

The two Indians ducked down behind the

snow wall. Bilal continued, “The Indian Army is going to get you killed by sending you here!” Then he heard the distinctive, two-click cadence of AK-47s cocking.

“We weren’t wanton killers,” Bilal says three decades later, recounting the story in his home in Rawalpindi. “We just wanted to preserve our own territory. We would defend it at all costs...that was our patriotic duty.” He is certain the Indians fired first. Bilal and his men returned fire. The crack of the shots was dampened by the snow and the thin air, and one of the Indians went down.

The Pakistanis stopped firing, and Bilal called to the other Indian. “Leave this place... We’re not going to take you prisoner, and we won’t shoot you in the back.” The Indian soldier stood up,

FOR THREE DECADES, INDIA AND PAKISTAN HAVE SENT YOUNG SOLDIERS TO THIS HARSH ENVIRONMENT FOR MONTHS AT A TIME

and Bilal watched him trudge away, panting for breath, until he disappeared into the mist.

Few outside of Pakistan and India took notice. And yet the Battle of Peak 22,158 bears a macabre distinction: It's the highest lethal ground combat ever recorded.

On a bluebird morning 28 years later, photographer Cory Richards and I shuffled awkwardly onto the boot-stomped snow of a helipad a few miles from the spot of that encounter. As professional mountaineers, we both had climbed peaks in the Karakoram and understood the effort and skills required simply to survive here.

For more than three decades, India and Pakistan have sent young soldiers to this harsh environment, where they remain for months at a time, guarding a remote, uninhabited wilderness. Observers began referring to the confrontation as the Siachen Glacier conflict, after the monumental sheet of ice that dominates the landscape where the disputed borders of Pakistan, India, and China meet.

Since 1984, the two sides have incurred thousands of casualties. A cease-fire was agreed to in 2003, but dozens of soldiers still die here each year—from landslides, avalanches, helicopter crashes, altitude sickness, embolisms, and other causes. Nevertheless, every year Indian and Pakistani soldiers eagerly volunteer to serve here. "It's seen as an extreme badge of honor," one Pakistani official told me.

Shelves of books, news articles, and scholarly papers have been written about the conflict, with authors often remarking on the absurdity of armies fighting over such useless territory. The general assertion is that two stubborn enemies, blinded by hatred, will go to the most extreme lengths to oppose each other, a notion crystallized by Stephen P. Cohen, an analyst at the Brookings Institution, who famously summed up the Siachen conflict as "a struggle of two bald men over a comb."

But the circumstances that prompted the two bald men to start fighting have never been fully explained. I'd spent four years following a paper trail of recently declassified documents and interviewing officials, scholars, and military personnel

in India, Pakistan, and the United States, trying to unravel an obscure but important mystery to the Siachen saga. And now Cory and I had come to Pakistan to see firsthand the consequences of what can happen from the seemingly simple act of drawing a line on a map.

THE GEOGRAPHER

On June 27, 1968, 21 years before Bilal led his team up Peak 22,158, Airgram A-1245 was sent to the Office of the Geographer, a little-known unit buried within the U.S. State Department's labyrinthine C Street NW headquarters in Washington, D.C. It eventually landed on the desk of 45-year-old assistant geographer Robert D. Hodgson.

Signed by William Weathersby, the chargé d'affaires in the U.S. Embassy in New Delhi, the letter began: "On various occasions... the Government of India has formally protested to the Embassy about U.S. Government maps which were distributed in India showing the status of Kashmir as 'in dispute' or in some way separate from the rest of India." It closed with a request for guidance on how to represent India's borders on U.S. maps.

For India and Pakistan, nations born from the bloodshed that accompanied Partition—the official term for the dissolution and subdivision of British India—maps were a matter of national identity. But for Hodgson and the other staff of the Office of the Geographer, they were a professional trade.

Every year the U.S. government published thousands of maps—by many estimates it was the largest map publisher in the world. Responsibility for depicting international political boundaries fell to the Office of the Geographer.

This mission gave the office considerable influence over far-reaching corners of the U.S. government, including the Department of Defense and the CIA. The office held the ultimate authority to depict the alignment of the world's

political borders as far as the official U.S. policy was concerned and, in turn, helped shape the way other nations viewed them. It also meant that, among the approximately 325 country-to-country land boundaries the U.S. recognized, the thorniest cartographic questions fell to Hodgson and his fellow geographers. Addressing these conundrums demanded a surveyor's sense of precision and a scholar's approach to research.

The term for this is "recovering boundaries," explains Dave Linthicum, an ebullient, bearded man who recently retired after more than 30 years as a cartographer for the CIA and the Office of the Geographer. "We're not drawing lines out of [whole] cloth. We're recovering the boundaries where they were placed in 1870 or 1910 or you name it with these old maps, old treaties."

Today Linthicum and his contemporaries spend a good part of their job poring over high-definition satellite imagery. By comparison, Hodgson, a former marine who'd been wounded fighting on Okinawa, began his career "map shagging" for the State Department while stationed in Germany from 1951 to 1957. Map shagging entailed driving around to local magistrates, pawing through archives of musty paper maps, and physically verifying the location of towns and geographic landmarks across the land. In the early days of the Cold War, a cartographic mistake could have cataclysmic consequences: In the event of a conflict, U.S. planes could be sent to bomb the wrong town, or possibly the wrong country, if a map was off by a few miles, or a slightly different spelling of a place-name was used.

Linthicum understands all too well how easy it is to make a mistake. A decade ago he was tasked with drawing the border between Nicaragua and Costa Rica as it follows the San Juan River to the Caribbean Sea. He drew the boundary as following an old watercourse rather than the river's current course, erroneously assigning a few square miles of an island to Nicaragua. Google Maps adopted Linthicum's line, and soon Nicaragua sent a platoon of 50 soldiers to occupy the island.

"Sometimes at work with my colleagues, it'll be, you know, why are you spending that much

time on this little [segment of a boundary], and then it winds up two weeks later that little tiny place—who would've thought—being very relevant or extremely important," Linthicum says. "Even if it isn't important in terms of military or intelligence, it's important to somebody... and getting their village, their house, or their fields in the wrong country is something that I definitely try to work at every day to avoid."

Unfortunately for Hodgson, the set of geopolitical and boundary issues that came across his desk in the form of Airgram A-1245 represented one of the most intractable to be found anywhere on the globe—a "cartographic nightmare," in the words of one geographer—the dispute over Kashmir.

AFTER WORLD WAR II, when the British relinquished control of the Indian subcontinent, they hastily decided to divide the region into two states based on the two dominant religions, India for Hindus and Pakistan for Muslims.

Commissions appointed by the British viceroy, Lord Louis Mountbatten, and made up of representatives from the two most influential political parties, the Indian National Congress and Muslim League, were convened to decide the new boundaries—an impossible task given that millennia of overlapping cultures and empires had left South Asia with intermingled populations of Hindus, Muslims, and Sikhs.

At the stroke of midnight on August 15, 1947, India and Pakistan gained their independence. Violence erupted as millions of frightened people tried to make their way across the new borders to join people of their religion. The conflict was bloodiest in the Punjab—the subcontinent's agricultural heartland. Overall, as many as two million people were killed in the chaos.

Under the terms of Mountbatten's plan, a mountain kingdom north of Punjab known officially as the Princely State of Jammu and Kashmir faced its own special dilemma. Although the population was overwhelmingly Muslim, Kashmir was ruled by a Hindu maharaja and was granted the option to determine which country it would join. But weeks after independence, militias of Pashtun tribesmen, with support



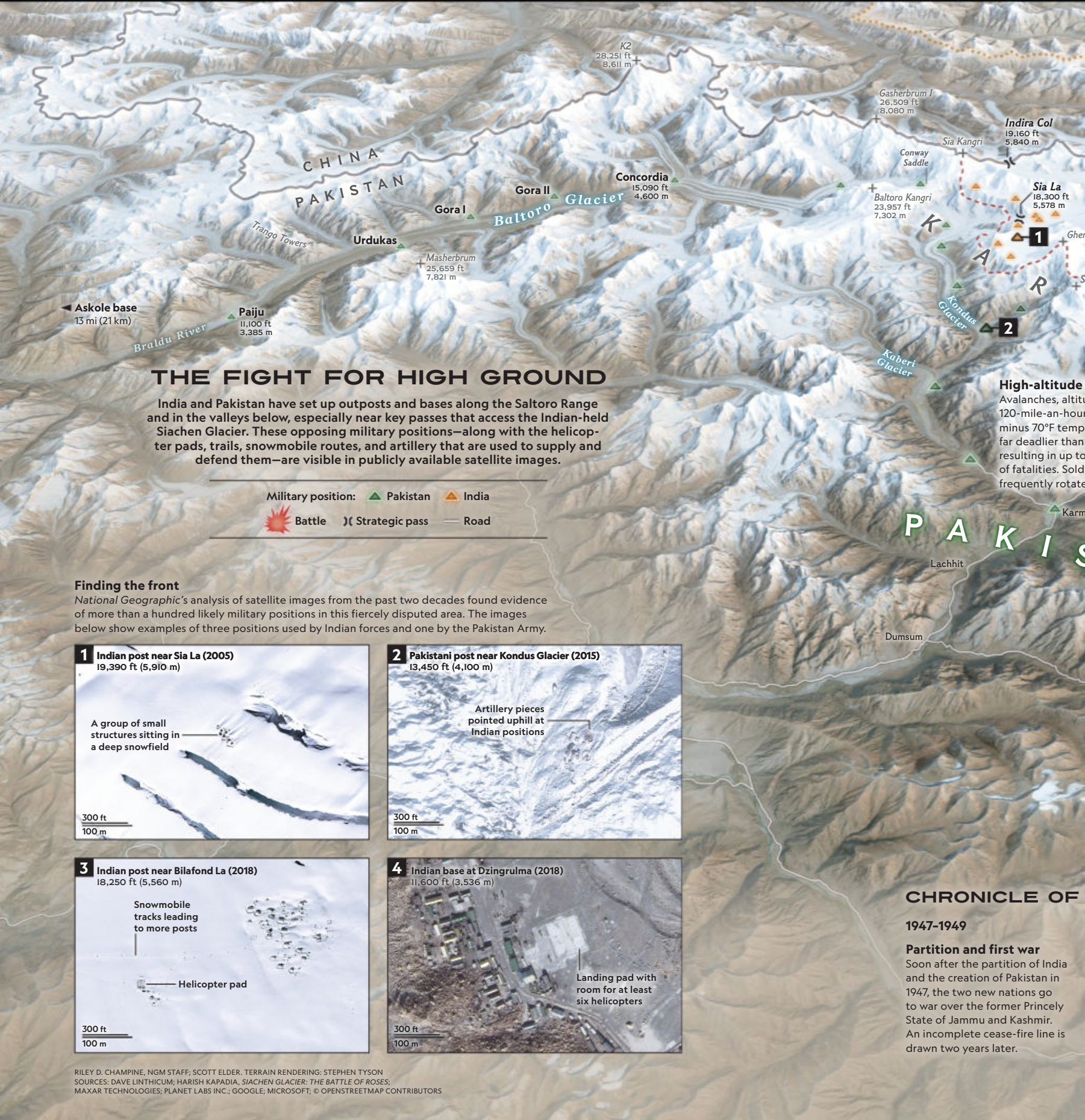
A game of cricket provides a dose of levity and exercise for men of the Pakistan Army's Punjab Regiment at Gora I, an administrative post at roughly 13,700 feet alongside the Baltoro Glacier. Mash-erbrum, a 25,659-foot peak and part of a sub-range of the Karakoram Range, shimmers in the distance under its blanket of snow and ice.

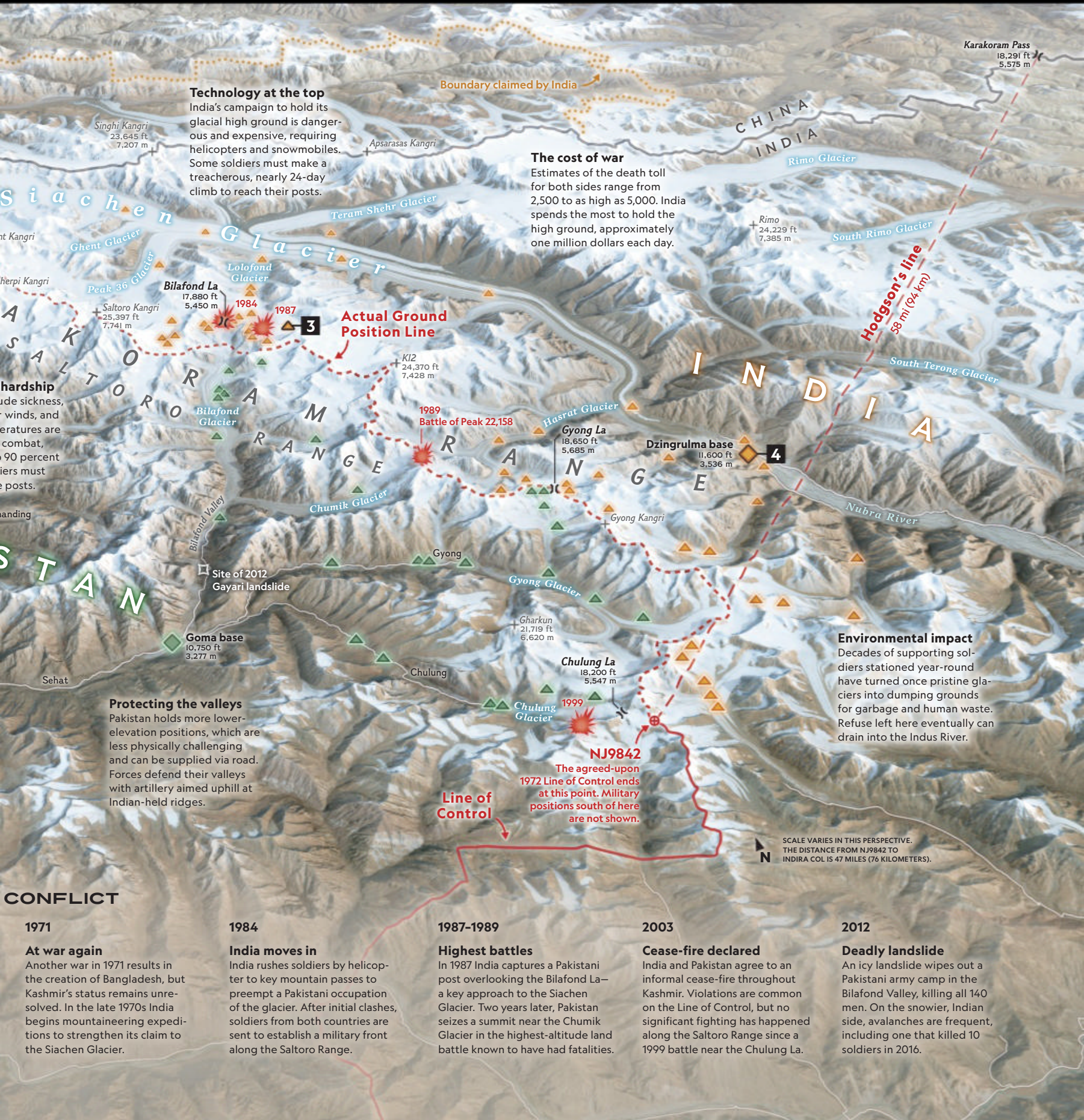




Pakistani soldiers receive instruction on how to operate a 37-mm antiaircraft gun. Hostilities ended in 2003 when a cease-fire was declared, but thousands of soldiers remain at the ready throughout the region. "If we withdraw, they will come," one soldier says of his Indian adversaries.









BORDER LINES IN DISPUTE

When British India was partitioned into India and Pakistan in 1947, the two countries' sovereignty over Jammu and Kashmir—a region of some 18 million people today—was not clearly defined. Since then, both countries have claimed the mountainous, glaciated terrain. The dispute over boundaries has created a geopolitical tangle on the world's highest-altitude battlefield.



Line of Control

India and Pakistan agreed to a cease-fire line in Kashmir in 1949; it was the basis for the Line of Control set in 1972. It stops short of the formerly uninhabited area of the Siachen Glacier, leaving a gap near the Chinese border.

Actual Ground Position Line

This approximate line represents the militarized front between India and Pakistan north of the Line of Control. National Geographic maps use this de facto line, as it best reflects the reality on the ground.

Hodgson's line

U.S. State Department official Robert Hodgson redrafted the map to close the gap in 1968. His line showed the Siachen area as controlled by Pakistan. India rejects this version and has occupied the glacier since 1984.

FOR THE INFLUENTIAL U.S. OFFICE THE GEOPOLITICAL AND BOUNDARY IS

from the fledgling Pakistan Army, began moving toward the maharaja's palace in Srinagar to claim Kashmir for Pakistan. The maharaja panicked and signed an Instrument of Accession to India. India responded with a military airlift and stopped the militias. Within weeks the new countries were at war.

When the dust settled, the opposing armies faced off along a hilly cease-fire line that wound through the middle of Kashmir. After a treaty brokered by the United Nations in 1949, teams of military surveyors from India and Pakistan, under UN supervision, set out to determine the cease-fire line. Both sides agreed it would be a placeholder until further negotiations could set a permanent border. But years went by without progress. Then in 1962, Chinese forces seized the Aksai Chin, a high desert region in the eastern corner of Kashmir, which further muddled the border question.

When Weathersby's airgram arrived in 1968, this was the complicated question Hodgson faced: How should the United States show this flummoxed state of affairs on its maps? If he went by Indian officials' claims, all of Kashmir legally belonged to India because of the Instrument of Accession the maharaja had signed. If he followed UN Resolution 47, as Pakistan argued, Kashmir was a separate entity, still awaiting a public referendum to decide which country to join. If he reflected the actual situation on the ground, Kashmir was sliced in two, under the de facto jurisdiction of the armies of India and Pakistan, with a small corner controlled by China.

THROUGHOUT THE 1960s, Indian diplomats protested how U.S. maps depicted Kashmir as being occupied territory or separate from the rest of India. "The correct position is that the entire State of Jammu and Kashmir is legally an integral part of India, with Pakistan and China in illegal occupation of areas west and north of the ceasefire line," read a 1966 objection.

After Partition, the U.S. and Pakistan had become Cold War allies, so it might seem that the U.S. would favor Pakistan in such a dispute.

But no document of the Geographical Society involved in the dispute had a reputation for honesty. The son hired to map the border could be seen in all honesty and then tell it like it was.

But there was the cease-fire line, fully divided by a coordination demarcation abruptly stopped by Chinese border.

The survey continued. The rugged heart of permanent natural resources to build military ing a definitive offered only beyond NJ9842.

In fact, the NJ9842. But the consequent winding river in the Karakoram blank space idea that this would have been.

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On September receiving W drafted his classified un long recognition production.

CE OF THE GEOGRAPHER,
ISSUES IN KASHMIR WERE

A 'CARTOGRAPHIC NIGHTMARE.'

ments found to date reveal that such considerations influenced the Office of the Geographer. By 1968 Hodgson had been handling many sensitive boundary issues. "He was a bit of a stickler," said Bob Smith, whom Hodgson joined the office in 1975. "Hodgson was always talking to the Greeks and telling them that their position was untenable, and to the Turks the same thing. He told them so."

There was one other crucial problem with the line through Kashmir: It didn't connect India and Pakistan. Instead, at a certain point, designated during the negotiation process as NJ9842, the line stopped nearly 40 miles from the Chinese border. This dead-end line is unique in cartography.

The mapping team had good reason not to close those last 40 miles cut through the heart of the Karakoram. It contained no major populations to protect, no known resources to exploit, and no easy access to any infrastructure. Instead of providing a definitive line, the final treaty documents gave very vague guidance for the section near NJ9842: "...thence north to the glaciers." There were many glaciers north of the line, but the largest and most strategically important was the Siachen, an immense, vertical wall of ice that cuts through the east-west divide. "Back then it was something of a mystery on the map," Linthicum says. "The terrain would be worth fighting over, and it struck all parties as absurd in 1949." In the fervid summer of 1968, as the U.S. fought the Vietnam War and political turbulence, Hodgson consulted with other officials at the State Department to determine the best way to draw the cease-fire line—including the roughly 40-mile gap.

On September 17, nearly three months after receiving Weathersby's airgram, Hodgson gave his response in a letter that remained classified until 2014. "The Department has recognized the difficulties involved in the drawing of a map of Indian international

boundaries which will not offend the host government and yet not compromise established American positions," it began.

Then in crisp, authoritative language, Hodgson laid out his guidance for how to show the 1948 cease-fire line on all official U.S. maps. But then he added: "Finally, the cease-fire line should be extended to the Karakorum [sic] Pass so that both states are 'closed off.'"

In a single sentence, Hodgson created a straight line traversing snow-clad mountains and high desert in a northeasterly direction to link NJ9842 to the Karakoram Pass, an ancient Silk Road byway on the Chinese border.

Why Hodgson did this remains unknown. He offered no explanation in the letter, and no notes have been found relating to the decision. But from his office on C Street, he must have seen obvious practical reasons.

In 1963 Pakistan and China had signed a bilateral agreement establishing the southeastern end of their shared Kashmir border at the Karakoram Pass, so many observers assumed that would be the logical end point for an Indian-Pakistani border as well. But since India had nothing to do with that treaty, Linthicum says, "it was invalid."

Linthicum suspects a mapmaker's fastidious desire to resolve ambiguity may have played a role. "Some people have the completeness syndrome—or completeness obsession—where you have to fill in the gaps." If both countries were to be "closed off" by the cease-fire line, as Hodgson wrote, the line would need to reach China to form a complete boundary—and the Karakoram Pass was the most identifiable point on the divide.

Yet Hodgson also seemed to understand that his boundary adjustments would be controversial. In a letter to the CIA, he urged maximum discretion. "We would prefer that the change take place gradually so as to reduce to a minimum possible international complications," he wrote.

Hodgson's hope to conceal the policy changes may have been wishful thinking. "After all, he should have considered the obvious," Linthicum says, "that map after map would soon be published, many released to the public, with

precisely the full visual evidence of the text in the new policy."

THE MOUNTAINEER

I first heard of the Siachen Glacier from a climbing buddy who said it held some of the most desirable unclimbed mountains in the world. "It's near the border with Pakistan," he told me. "They won't let anyone in there to climb." The summer after my wife and I got married, we traveled to India in search of first ascents in the Nubra Valley, just outside the Indian Army's militarized zone surrounding the Siachen. We—along with all the other mountaineers who've come to this region over the last 40 years—were following in the footsteps of Bull Kumar.

Standing just under five feet six inches tall, with swooping gray eyebrows and a deep, guttural laugh, Narinder "Bull" Kumar, 87, packed numerous adventures into a storied military career. Despite losing four toes to frostbite, Kumar led several ambitious mountaineering expeditions throughout the 1960s and 1970s, including an attempt on Mount Everest. Along the way he rose to the rank of colonel in the Indian Army and became something of a celebrity, meeting Prime Minister Indira Gandhi and forging a friendship with Tenzing Norgay, who, with Edmund Hillary, was first to summit Everest.

Before Kumar died last December, I visited him in New Delhi to hear about his encounter with two German adventurers who approached him in 1977 with a plan to make the first descent of the Nubra River, a chalky deluge that drains from the Siachen. Kumar would later write in his memoirs that when one of the Germans unfolded a map to explain their plan, "I looked at the map and my eyes got stuck." He asked the German where he got his map and was told it was a U.S. map, used all over the world.

Kumar said nothing but soon recognized the

A well-maintained path leads to a rock patio for prayer at the Gora I post. “We never discuss hardships with our families,” one soldier says. “We just say we are happy and enjoying life.”



glaring problem: “The line of control, which was then called Cease Fire Line and ended at point NJ9842, had been mischievously or inadvertently or deliberately [altered].”

Thus, Bull Kumar discovered Hodgson’s line.

He took his discovery to Lt. Gen. M.L. Chibber, then India’s director of military operations. Pakistan is occupying thousands of square kilometers of land on its own, he thundered, “and we know nothing!” As supporting evidence, Kumar and Chibber soon learned from the *American Alpine Journal* that a Japanese mountaineering team, accompanied by a Pakistan Army captain, had visited the upper Siachen two summers before. Kumar offered to lead a patrol under the guise of a mountaineering expedition to gather intelligence. More Indian patrols followed in the late 1970s and early 1980s, while Pakistan authorized

several additional climbing expeditions to the glacier during the same period. In August 1983 the Pakistan Army sent a formal note of protest to its counterparts in India: “Request instruct your troops to withdraw beyond Line of Control south of line joining Point NJ9842, Karakoram Pass NE 7410 immediately. I have instructed my troops to show maximum restraint. But any delay in vacating our territory will create a serious situation.”

The Pakistan Army was now claiming Hodgson’s line as its boundary. By then, the line had been included in dozens of maps printed by numerous agencies, all under the seal of the U.S. government. Such was the quiet influence of the Office of the Geographer that the boundary had spread to commercial publishers. Beginning in 1981, it showed up in the *National Geographic Atlas of the World* as a tiny dotted line less than an



inch long. (National Geographic stopped showing the line beginning with the atlas's 2020 edition.)

But Robert Hodgson didn't live to see the mounting tensions over his line. In December 1979—several months after news of Kumar's expedition was published—Hodgson, who'd been promoted to head the Office of the Geographer, died of a heart attack. He was 56.

THE SOLDIER

On April 13, 1984, the Indian Army launched Operation Meghdoot, named after a Sanskrit word

meaning “cloud messenger.” Using helicopters, the army inserted a platoon of soldiers to occupy the Bilafond La, one of the mountain passes favored by climbers coming from Pakistan. Soon it occupied two more passes. With these moves, India controlled the Saltoro Range, which would become the front line in the fight over the Siachen Glacier and has shaped the archipelago of military outposts that defines the stalemate today.

Accounts from the front lines of the Siachen conflict often are couched in romantic notions of patriotism, but spending weeks or months at high altitude is far from romantic. At about 18,000 feet above sea level, the human body, starving for oxygen, begins to break down. Given enough time, death is inevitable.

But on the Siachen and surrounding glaciers, the two armies occupy more than a hundred permanent high-altitude posts. To maintain these camps requires an astounding logistical effort—essentially planning more than a hundred mountaineering expeditions simultaneously and maintaining them in perpetuity.

In 2011 Cory Richards camped near one of the Pakistani outposts during a winter expedition to Gasherbrum II. There he found the frozen wreck of a crashed helicopter and a platoon of curious soldiers living in spartan camps. “We had internet, so they would come over and we would have tea,” he says. “They asked if they could use my Facebook.”

It was partly that encounter that had led us to ask the Pakistani government to let us document life on the Siachen front lines. Through the years other journalists have made this trek, and it was clear the Pakistan Army had a practiced script for visitors as we sat for the first of several briefings during our tour of some of its bases.

“In the face of all odds, the Defenders of K2 occupy the highest military positions anywhere in the world,” a captain from the 62 Brigade told us. “This would be a solid point to be included in your story.”

From its headquarters in the town of Skardu, the 62's supply line snakes up the Braldu Valley to the Conway Saddle, a pass that rises to almost 20,000 feet. The last half of the journey is accessible only by foot or helicopter. The army made us walk so that we could acclimatize.

The trail looks easy on the map—a broad, nearly treeless valley etched by fields of boulders and gushing streams. “For you this is fun,





Soldiers pass a glaciated side valley on their way to Gayari, where a similar ice field released an avalanche some 2,500 feet above a Pakistani battalion headquarters in 2012. Ice engulfed the encampment and killed 140 people.





Four enlisted men maintain the post at Urdukas, perched above the Baltoro Glacier at 13,200 feet. Soldiers struggle with boredom, but Pakistan's army prides itself on discipline. "If they tell us to climb a mountain, it's 'Yes sir,'" one officer says. Administrative posts lie along logistical supply lines, while observation posts are at or near the front lines, with a view of the enemy.

‘WE HAVE TO FIGHT NATURE HERE, AND NATURE
IS UNPREDICTABLE,’ THE DOCTOR SAID RUEFULLY.

but we do this every day,” one soldier told me on our first morning of walking. By the time we reached a camp known as Paiju, our joints were stiff and our feet tender.

The living conditions there are relatively comfortable. A generator and some satellite dishes provide an unreliable connection to the outside world. In the officers’ quarters, a tangle of tenuously spliced wires connected to a small TV allows for evening entertainment.

“We use it for watching motivational movies,” one man told us. “Like *Rambo*?” Cory joked.

“Yes, exactly,” the man replied, straight-faced.

Other posts don’t have it so easy. Urdukas, a tiny outpost of three prefabricated Styrofoam igloos set on a spectacular perch at 13,200 feet, is occupied by just four enlisted men. “It’s very boring,” one soldier whispered over roti and sinewy chicken stew. “There’s no mobile, no movies.” During winter, Urdukas receives only four and a half hours of sunlight a day. The camp is surrounded by hundreds of jerry cans holding kerosene—the soldier’s lifeblood, providing cooking fuel and warmth. Inside each shelter, everything is covered with soot. Here the only extravagances are *naswar*—a coarse variety of chewing tobacco—and ludo—a Pakistani version of pachisi played on homemade game boards. “If there are officers, it’s more comfortable,” one soldier said.

The next day we met a dozen soldiers heading down after a three-week patrol. Their demeanor was festive. I chatted with a friendly captain, a doctor, as he smoked a cigarette.

“It was OK on this patrol,” he said. “We had to evacuate three men for high-altitude cerebral edema, but this is normal.”

Until 2003, the two sides regularly traded artillery barrages and sniper fire, but a cease-fire agreed to that year has left little for soldiers to do other than watch one another and survive the elements. “It’s like a football match,” another captain told me of life on the front line. “Usually we warn by raising a red flag. We warn, ‘Please stop whatever you’re doing. Our guns are ready to fire.’ As an answer, they raise the white flag to say, ‘OK, we’re stopping.’” Otherwise, each day

is measured in cigarettes and cups of tea, games of volleyball or cricket, prayers and daily chores.

Both India and Pakistan have learned from their 35 years of mountain warfare how to care for their soldiers in this environment. Army doctors identified carbon monoxide poisoning and embolisms as common issues caused by soldiers spending too much time sedentary in snowbound posts. Soldiers now are required to exercise every day. “Every S.O.P. [standard operating procedure] is written in blood,” one colonel said.

Before coming here, many of the soldiers we met had seen combat in Pakistan’s tribal areas bordering Afghanistan, part of the Pakistani government’s effort to confront Islamic terrorism. “We have to fight nature here, and nature is unpredictable,” the doctor said ruefully. “Humans are easier.”

IN THE AUTUMN OF 1985, more than a year after India had seized the Siachen and 17 years after Hodgson’s line was published, an Indian diplomat sent an official inquiry. It eventually reached the desk of the State Department Geographer at the time, George Demko, who, like Hodgson, was a former marine and had served in Korea.

More than a year later, Demko issued an update to the mapping guidance that stated the Office of the Geographer had reviewed the depiction of the India-Pakistan border on U.S. maps and had found “an inconsistency in the depiction and the categorization of the boundary by the various [map] producing agencies.” To correct this depiction, he wrote, “the Cease-Fire Line will not be extended to the Karakoram pass as has been previous cartographic practice.”

Hodgson’s line had been erased. Although the line was removed from U.S. maps, the Office of the Geographer offered no explanation for why it had appeared on them in the first place.

A few years after Demko’s correction, Robert Wirsing, a scholar at the University of South Carolina who’d been closely following the Siachen conflict, began inquiring about the line that had once appeared on U.S. maps and then disappeared. Wirsing, who’d learned from an Indian general that the Indian government had

asked for an explanation to no avail, sent letters to the State Department and the Defense Mapping Agency, asking about its origins.

In 1992 Demko's successor, William Wood, responded. "It has never been US policy to show a boundary of any type closing the gap between NJ 9842 and the China border," he wrote. Wirsing did not pursue the matter.

THE AFTERMATH

Pakistani officials never agreed to take Cory and me to any point near the front line where we might get a glimpse of point NJ9842. I'm not sure exactly what I expected to see that I couldn't make out from zooming in on Google Earth. It's just a human-created designation—a lonely spot on a glaciated ridge with an Indian Army encampment nearby.

Instead, the officials offered to show us another spot. We loaded into jeeps and jostled along a dirt track leading up the cavernous Bilafond Valley. Directly above us, brilliant granite summits glistened in the morning sunlight, though the valley floor remained obscured in deep shadows. We stopped at the edge of a large boulder field.

On this spot, just before 2:30 a.m. on April 7, 2012, the Pakistan Army suffered its worst defeat in the Siachen conflict, though one the Indians had no part in. A massive landslide released above a camp serving as a battalion headquarters—the same camp from which Abdul Bilal had planned his assault. Soldiers at an artillery base a mile and a half away reported a loud rumbling noise, excessive snow particles in the air, and a lone dog barking forlornly.

"It was beyond imagination," Maj. Gen. Saqib Mehmood Malik said. One hundred and forty men housed in a dozen buildings had been buried under more than 100 feet of rock, ice, and snow. It was months before the first body was found.

Cory and I made our way through the still

dangerously unstable field of debris. Crude signs fashioned from corrugated roofing marked where the barracks buildings had stood—each painted with the numbers of bodies recovered there.

"It's a strange feeling, but a matter of extreme pride to come here," one officer told us. But I was left wondering: Did these people die because of a geographer's mistake?

Hodgson's line "definitely played a role in leading to the war. It did not result in the war, but it was most decidedly a factor," Dave Linthicum says. "The phrase 'smoking gun' was used," he says of the moment he discovered Hodgson's airgram buried in State Department records. For years Linthicum kept a photo of Robert Hodgson taped above his office workspace, "as a reminder to myself not to f-up," he says, "and be responsible."

Wirsing agrees the line played a role in the conflict, but he adds, "I have no reason to think someone deliberately decided to hand this territory to Pakistan." He also has no reason to believe any peace agreements will be negotiated soon. "I have friends who say [the Siachen Glacier] should be converted into an international peace park," he says. But recent events, he notes, including continued violence in Kashmir and border tensions between India and China, make a resolution of the issue seem improbable anytime soon.

Wirsing doesn't necessarily agree with the "two bald men fighting over a comb" analogy. "'Irrational' is a word I encountered so often in scholarly discussions and writing about Indian-Pakistani relations," he says. "I do not attribute much that happens between India and Pakistan to their emotions... I believe they're there for pretty good reasons, even strategic reasons... given the fragility of boundaries in that area."

Indeed, so long as humankind endeavors to divide up our planet into neat polygons, some of those lines are destined to be disputed, and men like Abdul Bilal and Bull Kumar will be sent to fight over them. Geography dictates its own terms. □

Freddie Wilkinson wrote about installing weather stations on Mount Everest in the July 2020 issue.

Cory Richards's photographs of the Okavango Delta appeared in the November 2017 issue.

THEY'RE OFF



Greyhound racing in the U.S. is on its last leg after Florida ended betting at dog tracks amid concerns about how the animals are treated.

BY CRAIG PITTMAN

PHOTOGRAPHS BY ERIKA LARSEN



AND GONE

RIGHT

Susan Butchko pets her recently adopted dog, a retired racing greyhound named Remy. She has been fostering and adopting greyhounds since 1999.

Before the 1980s, greyhounds that retired from racing often were euthanized or sold to laboratories.

PREVIOUS PHOTO

Sleek greyhounds thunder around the sandy oval at Derby Lane in St. Petersburg, Florida, in August 2020. Derby Lane, the oldest continuously operating dog track in the U.S., and two other Florida tracks closed in December. Voters effectively ended the sport when they opted to ban betting on dog races because of concerns about mistreatment of the dogs.

IT'S 8:30 ON A SATURDAY night in August. A gibbous moon hangs low in the sky, its glow no competition for the neon sign proclaiming GREYHOUND RACING and DERBY LANE.

About 300 people are scattered in the grandstands here in St. Petersburg, Florida, that once held thousands, murmuring as loudspeakers play big band and rockabilly. They fall silent when Frederick Davis leads the parade of dogs.

"TNT Sherlock," says the announcer, calling for the first of the eight sleek animals as Davis halts them in front of the stands. Each dog wears a number attached to a snug vest known as a blanket. "Tailspin," the announcer calls, "Charlotte York..."

Next, Davis, 41, and the eight handlers he supervises put the dogs in the starting box. A mechanical rabbit named Hare-son Hare zooms past, squeaking and shooting blue sparks. The doors fly open, and the greyhounds burst onto the track in a blur of acceleration. Their paws toss sand in the air as they gallop around the oval for 30 seconds, hitting speeds of up to 45 miles an hour.

Derby Lane, which opened in 1925, was once hailed as the Churchill Downs of greyhound racing. Back when the dogs were running last year, you could still get a hint of the glamour and excitement of the track's glory days in the 20th century. Back then, the stands would be packed with fans in suits and hats. Babe Ruth and entertainer Sophie Tucker were visitors. Joe





DiMaggio once left Marilyn Monroe in an idling car while he ran inside to place his bets.

Derby Lane was America's oldest continuously operating greyhound racetrack, but in December 2020 it headed for its final stretch. Two years earlier, Florida had more greyhound tracks than any other state—11 out of 17 nationwide. By the end of 2020, it was down to three, with about 2,000 dogs still racing. Now those tracks are closed too.

In 2018 Florida's voters had the chance to approve a constitutional amendment—Amendment 13—to ban betting on greyhounds as of December 31, 2020. The racing industry bet on Floridians rejecting the amendment, but it passed by a wide margin, owing mostly to the growing national concern over the mistreatment

of animals in the entertainment field, such as circuses.

Derby Lane's last race was scheduled for December 27. Davis, a slender man with dreadlocks and a quick smile, was one of scores of employees whose future was uncertain. He'd been at the track for 14 years and considered it his ideal job.

"I love dogs," Davis said, "and I love being outside."

He was not the only Derby Lane employee wondering what would happen next.

"It's a shame to have to shut down after 95 years," said CEO Richard Winning, 64. His family has owned Derby Lane since it opened in 1925. With the Florida tracks closed, he warned,

tracks elsewhere undoubtedly would follow. “In 20 years, will anyone even remember what greyhound racing was?”

This is the one thing on which he agrees with Carey Theil, whose Massachusetts-based advocacy group Grey2K USA spearheaded the drive for Amendment 13: Shut down Florida’s tracks, and there goes the industry.

“Florida really was the industry,” Theil says.

THE GRAY-BEARDED WINNING is a born storyteller. He started at the track 45 years ago, collecting half-dollars from the turnstiles. He remembers when the regulars included rakish gamblers named “the Flicker” and “Champagne Tony,” the track restaurant served a 37-ounce prime rib, and a live band played between races.

Winning says greyhounds are the only dog breed in the Bible. That’s sort of true. The King James Version of Proverbs 30:29-31 cites them as “comely in going.” (Scholars say the original Hebrew refers to Afghan hounds or salukis.) The king’s translators knew about greyhounds because of a then popular sport called coursing, in which two greyhounds race to catch a rabbit. Queen Elizabeth I loved it—hence greyhound racing’s nickname, the “sport of queens.”

Dog racing as we know it today originated with an American inventor named Owen P. Smith, who was moved by the grim deaths of the rabbits to come up with an alternative. Smith’s idea was to replace the live rabbit with a mechanical one. In 1910 he secured a patent for what he called the Inanimate Hare Conveyor.

“Nobody in the history of any sport brought about a change comparable to that worked by the inventor of the device, and yet no inventor in sports history is so little known,” *Sports Illustrated* commented in 1973.

Smith and two partners also designed the first modern greyhound track, the Blue Star Amusement Company, which opened in 1919 outside Oakland, California. It failed, as did several others, because it didn’t allow betting. Gambling, while popular, was illegal.

The first successful track, the Miami Kennel Club, was one Smith and his partners opened in 1922 in a swampy Florida locale known as Humbuggus. It was so close to the Everglades that the owners employed a snake catcher to snag stray reptiles. The key to its success was

the use of electric lights, according to Gwyneth Anne Thayer, author of *Going to the Dogs*, a book on greyhound racing and its place in popular culture. Lights meant that races could be run at night, when working people could attend. Amid Florida’s 1920s land boom, thousands of new residents sought evening entertainment. (The track later was converted to horse racing and renamed Hialeah Park.)

In 1925, on the other side of the state, Derby Lane opened under a cloud. The partners who built it ran out of money, so lumber magnate T.L. Weaver, Winning’s great-grandfather, took possession. He grew beans in the infield, track historian Louise Weaver says. Between races, he once had monkeys ride the dogs, their uniforms sewn to the greyhounds’ blankets so they couldn’t escape and the dogs couldn’t buck them off.

Although betting was illegal, the tracks “did something sneaky,” Winning said. “They sold shares in the dogs.” Winners would get a “dividend.” Losers would not. Other tracks ran “on the fix”—meaning they’d keep operating until raided and open again once the coast was clear.

In 1931, with the Great Depression bankrupting local governments, Florida legislators passed a bill to legalize and tax betting on the races. Governor Doyle Carlton, a devout Baptist, opposed it. Years later, he said gamblers offered him \$100,000 to sign the bill. Instead, he vetoed it. State senators overrode his veto, making Florida the first state to legalize betting on dog races. Dog tracks then popped up in Tampa (1932), Orlando and Jacksonville (1935), Pensacola (1946), and Key West (1953).

Greyhound racing became part of Florida’s sun-and-fun image. Mickey Mantle filmed a cigarette commercial at Derby Lane. Boxing champs and movie stars hung out at the tracks. The 1959 movie *A Hole in the Head* shows Frank Sinatra betting on Miami dog races.

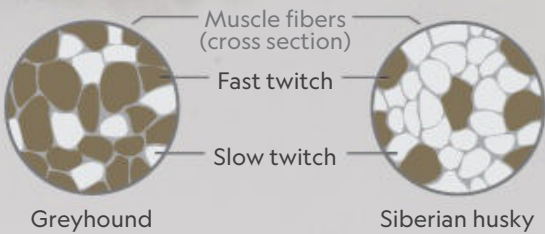
FLORIDA CAN BE a sunny place full of shady people. The money involved in dog racing attracted plenty of them. Winning recalls Tampa mobster Santo Trafficante, Jr.’s minions placing bets at Derby Lane. Some mafiosi were more than customers. Charles “Lucky” Luciano and Meyer Lansky held an interest in South Florida dog tracks, says Scott Deitch, author of seven books on the Mafia.

READY TO RUN

Long bred for sport hunting, greyhounds more recently have been bred to race. Their anatomy and gait are ideal for bursts of speed up to 45 miles an hour, making them the world’s fastest breed. But those attributes also make them susceptible to fractures and spinal complications that rarely afflict other dogs.

POWERFUL LEGS

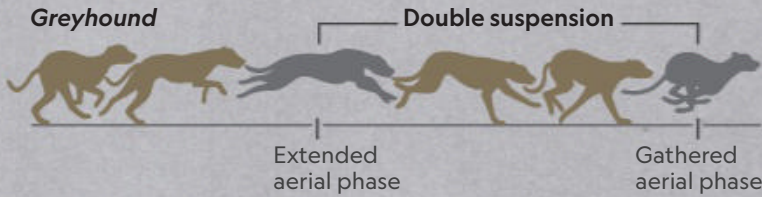
They’re propelled by very long foot bones (for leverage) and high muscle mass. Their rump and thigh muscles are larger than those of most other breeds.



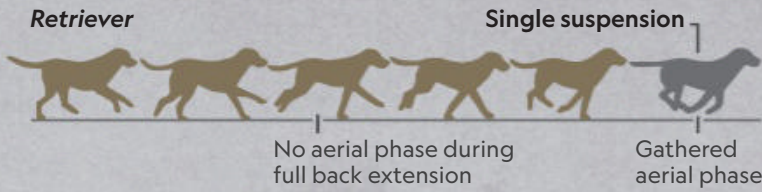
Fast-twitch muscle fibers support quick, powerful movements such as sprinting and jumping. Dogs built for long distance and endurance, such as Siberian huskies, have more slow-twitch fibers.

A RACER’S CAREER

12 months		18 months	3-4 years	Expected life span of 12-15 years →
GROW		TRAIN	RACE	RETIRE
Litters are reported to the National Greyhound Association. Puppies’ right ears are tattooed with their birth date and litter order; a registration number is tattooed on the left ear.		Dogs first run on straight sprint paths. Then they train on small circular tracks—chasing a lure at the end of a pole—before moving to larger tracks, chasing mechanical lures.	Racers compete twice a week on average, often traveling to multiple tracks in different states. When not competing, they rest in crates and are routinely let out to walk, stretch, and play.	At about age four, greyhounds are past their racing peak. Some retired dogs are used for breeding; most are adopted as pets. Activists tracking the industry have noted instances of abuse and killing of some racers.



A greyhound can be airborne 75 percent of its racing time, when it’s aloft twice per full gallop. Most other breeds, such as retrievers, are aloft only once per gallop.



A body fat content of just 2 percent and a thin layer of fur make it harder to stay warm.

A keen sense of sight aids in chasing fast-moving prey.



Racing muzzles keep sand out and help identify dogs in finish line photos.

A deep chest maximizes lung power and holds an especially large heart.

Angling to the left at racing speed can cause stress fractures and other injuries in the ankle, wrist, and foot.



SPEED IS IN THEIR BLOOD

Greyhounds’ large spleens store a high number of red blood cells, which are released into the bloodstream at the start of a race. This thickens the blood and prompts quick vessel dilation, oxygenating muscles for high performance.





**Both sides
in the
greyhound
racing
debate agree
on one thing:
Shut down
Florida's
tracks, and
there goes
the industry.**

Greyhounds stretch their legs between races in the turnout pen at Farmer Racing, owned by champion trainer John Farmer. He let them lounge in the pen five times a day for up to two hours in 2020—muzzled to prevent playful nips—so their crates could be cleaned and food prepared. When Florida closed its tracks, Farmer planned to take his dogs to West Virginia, one of the three states where there are consistent racing seasons; the other two are Iowa and Arkansas.

Mob involvement sparked rumors about fixed races. Bettors said dogs were overfed to slow them down, or their toes cinched up with rubber bands to hamper their ability to run, or they were drugged to make them faster or slower.

Doping remained a problem into dog racing's last years. In 2017 state officials revoked a Derby Lane trainer's license because five of his greyhounds tested positive for cocaine, a stimulant. Months later, a trainer at another Florida track was suspended after a dozen dogs tested positive. In the two years that followed, state officials say, 11 more trainers' dogs tested positive.

Doping has been just one of racing opponents' concerns. Grey2K has spent nearly 20 years compiling reports on the welfare of racing greyhounds. It contends that even standard industry practices constitute mistreatment. It says dogs are forced to race under conditions that can cause serious injuries, such as broken legs and backs, fractured skulls and spines, and even electrocution by the lure. Another concern is what becomes of dogs that aren't racing. In 1952 the Greyhound Racing Record said 30 percent of greyhounds bred for racing would compete, leaving open the fate of the other 70 percent. Dogs that do race stop being competitive around four years old. Grey2K has collected a raft of stories about greyhounds being euthanized or sold to laboratories. To address those concerns, in 1987 the industry formed the American Greyhound Council to set up adoption agencies and study what's best for the dogs. Two of the worst scandals occurred in the 2000s, however.

In 2002 a former Pensacola track guard was arrested after authorities discovered that he'd killed 1,000 to 3,000 greyhounds and buried them on his property in Alabama. He said he'd been paid \$10 each for shooting them. A prosecutor called the guard's property a "Dachau for dogs," according to a story in the *New York Times*. The guard died before he could be tried. In 2010 a trainer at a track in the Florida town of Ebro left dozens of dogs to die after the racing season ended. He pleaded guilty to cruelty, drawing a five-year sentence.

THE SCANDALS CUT into greyhound racing's popularity at a time when the public's concern for animal welfare was rising. Meanwhile, new competing gambling operations—the Seminole and Miccosukee Tribes' casinos



and the Florida Lottery—lured customers from dog tracks.

The fans who remained skewed older. In 2001 Steven Soderbergh filmed a scene for *Ocean's Eleven* at Derby Lane that featured George Clooney and Brad Pitt recruiting a man for their robbery scheme. Their target, Carl Reiner, then 79, fit in perfectly with the graying greyhound crowd.

In the track's final days, its typical fan was Jim Wickert, 77, a retired golf course owner who since 2003 had shown up at Derby Lane twice a week in his tan Orvis fedora. He said he enjoyed the challenge of handicapping the dogs' chances.

"I like trying to figure them out," he said. "I don't bet big, but it's still exciting when you do figure things out and they run the way you think they should."

He was unsure what he'd do once the track closed. Nothing else seemed as exciting.

Some people got into racing because they



LEFT

Dog collars hang above a tub filled with raw beef and rice as Farmer prepares to feed about 60 dogs. When they're racing, the dogs' daily diet consists of about 90 pounds of beef, mixed with commercial dry dog food, water, electrolytes, rice or macaroni, multivitamins, and blood builders to fight anemia.

BELOW

Flamenco Dancer was one of Farmer's champion racing dogs. From 2017 until the dog's retirement in 2020, Flamenco Dancer, also known as Bunny, earned more than \$63,409, which was split among Farmer and the dog's owners. Most dogs stop racing at about four years old, when they slow down.



Florida's exit means that only three U.S. states—West Virginia, Iowa, and Arkansas—now have consistent racing seasons. Animal welfare advocates are seeking to ban dog racing throughout the U.S. and in several other countries.

Veterinarian Donald Beck and trainer Kelsie Gubbels care for BD Wells, who suffered a leg injury, likely from bursting out of the starting box too hard. Beck said that in 30 years at Derby Lane, the dogs never tried to bite him.





love greyhounds. Trainer and kennel owner John Farmer, a Klamath Tribe member from Oregon, said he fell in love with the breed when he was 11 and his mother let him watch races at Multnomah Greyhound Park. Now 55, he carries mementos of his winning dogs in an overflowing Tupperware container.

Greyhounds are affectionate animals, not particularly high-strung, said longtime veterinarian Donald Beck. In his time at Derby Lane, Beck said he was never bitten—but he had been scratched by excited dogs jumping on him.

When Winning recalls racing champions, one stands out: Keefer, the dog that won Derby Lane's 1986 Distance Classic. That race drew 12,779 people—the largest crowd in track history. By 2020 Saturday races drew maybe a thousand.

The money brought in by live greyhound racing in its final decade dropped from \$117 million a year to less than \$40 million. At Derby Lane, it fell from \$12 million to \$4.3 million.

The industry tried to adapt, winning legislative approval in 1996 for poker rooms and for simulcasting, which lets bettors wager on races elsewhere. The poker rooms remained packed. After dog racing ended, simulcast races drew some fans. But they couldn't save the dog tracks.

FOR A DECADE, GREY2K tried to persuade Florida legislators to reform greyhound racing, to no avail. Finally, the group appealed to the state's Constitution Revision Commission, which meets every two decades, and persuaded commissioners to support a proposal to end racing.

The organization and its allies spent three million dollars advocating for Amendment 13, Theil says, mostly for TV ads showing mistreated racing dogs. Two groups opposing the amendment spent just \$534,000 in response. One of the groups' ads accused Grey2K of exaggerating the danger.

"The vast majority of the dogs are well trained, well treated, and well loved," said Jack Cory, of the Florida Greyhound Association. He called Grey2K "pathological liars."

Yet the industry drew little support beyond its fan base. Nearly 70 percent of the voters said yes to the amendment.



ADOPTING A GREYHOUND

There are about 300 greyhound adoption agencies in the U.S. The Greyhound Project (adopt-a-greyhound.org/directory/list.cfm) maintains a searchable directory. If you adopt a greyhound racer, remember it has been trained to run. You may have to teach the dog some basics. Also, it likely will be unfamiliar with other dog breeds or pets, such as cats, and will need time to get used to them.



At Sharon Dippel's Florida home, a retired racing greyhound named Fly to Barcelona—now called Roxanne—climbs out of the swimming pool. Dippel runs a greyhound adoption agency, and she and her husband also have eight adopted dogs. Greyhounds are gentle and affectionate, she says, and when not running outside, they "sleep 80 percent of the day."

Besides the track employees losing jobs, the shutdown affected trainers and kennel owners. Farmer, for example, said he would relocate to West Virginia, one of the three remaining states (along with Iowa and Arkansas) that still have consistent racing seasons.

Grey2K USA is working to have racing banned in those states and in Australia, Ireland, Mexico, New Zealand, the United Kingdom, and Vietnam.

Greyhound adoption agencies set about finding homes for the Florida dogs that were still racing as of December 2020. One of those organizations was GST's Sun State Greyhound Adoption, run by Sharon Dippel. She and her husband, Brian, have eight adopted

dogs themselves. They go through a couple of 44-pound bags of dog food every 10 days or so.

Dippel said plenty of people lined up to adopt dogs. It helped that Florida's tracks didn't shut down simultaneously. Some closed shortly after the 2018 vote, others in early 2020 because of COVID-19.

As pets, greyhounds still like to run when they get outdoors, even without a mechanical device to chase, Dippel said. But when they get back indoors?

"They're a 45-mile-per-hour couch potato." □

Craig Pittman is the author of five books on Florida, his native state, and cohost of the "Welcome to Florida" podcast. **Erika Larsen** documents cultures that maintain close ties with nature.



INSTAGRAM

CRISTINA MITTERMEIER

FROM OUR PHOTOGRAPHERS

WHO

A conservation photographer, writer, and adventurer

WHERE

On the public breakwater promenade at Santa Cruz Island in the Galápagos

WHAT

A Sony A7R3 camera and 100-400mm lens

When in the Galápagos, keep your camera ready. After a day spent snorkeling with sea lions, Mittermeier sat down to have a cocktail when she spotted thousands of Sally Lightfoot crabs perched on volcanic rocks nearby. Wildlife abound on the famous islands—but increasingly are threatened. After photographing the crabs, Mittermeier took a short walk to a beach. There she saw countless strewn plastic bottles and bags, trash that is choking the islands’—and the planet’s—wild ecosystems.

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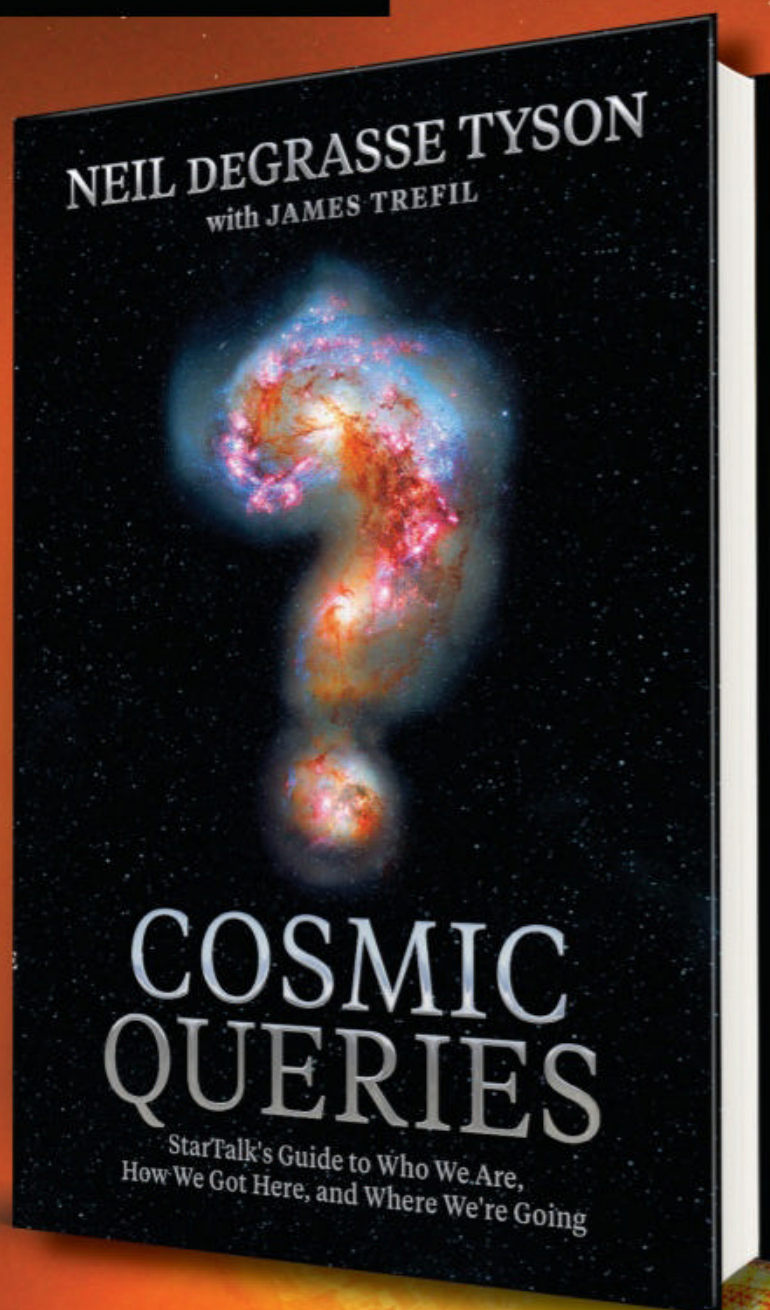


UNLOCK THE SECRETS OF THE COSMOS

FOR SCIENCE GEEKS, SPACE AND PHYSICS NERDS, AND ALL WHO WANT TO UNDERSTAND THEIR PLACE IN THE UNIVERSE, this enlightening new book from celebrated astrophysicist Neil deGrasse Tyson offers a unique take on the mysteries of the cosmos, building on rich material from his beloved *StarTalk* podcast.

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